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UNIVERSITY REGISTRATION STATISTICS.

THE statistics given on page 798 are, with few exceptions, approximately as of November 1, 1906, and relate to the registration at twenty-three of the leading universities throughout the country. Two new institutions have been added to the list, the University of Kansas and New York University. The figures have in every case been secured from the proper officials of the university concerned; wherever detailed information has been furnished with reference to causes of increase or decrease in registration, changes in equipment, etc., the material is set off by smaller type. At the majority of institutions, additional registrations during the remainder of the academic year will increase somewhat the figures given in the table. This is especially true in the case of an institution like Columbia, which admits new students to its academic department in February, as well as in September.

Comparing the figures for 1906 with those for 1905, it will be seen that a number of institutions show a loss, which, in the case of California (−10.61%) and Leland Stanford (−4.73%), may be traced to external causes. The other universities that have suffered a decrease in attendance are Johns Hopkins (−10.17%), Northwestern (−5.59%) and Columbia (−2.21%). The greatest gains have been made by Pennsylvania (14.69%), New York University[1] (12.74+%), Indiana

[1] The Kansas and New York University figures for 1902 to 1905, and the Nebraska figures for

(10.02%), Missouri (9.75%), Syracuse (8.21%), Virginia (7.04%), Nebraska (6.52%), Ohio (5.98%), Cornell (5.27%), Illinois (4.81%), Chicago (3.59%) and Michigan (3.38%). Harvard (1.14%) and Wisconsin (0.52%) show slight gains, while the registration at Kansas,[1] Minnesota, Princeton and Yale has, to all intents and purposes, remained stationary.

If we compare the registration of 1906 with that of 1902, we shall find that every university, with five exceptions, has increased its registration during the intervening period, the exceptions being California (−11.71%), Northwestern (−8.35%), Indiana (−8.07%), Johns Hopkins (−7.62%) and Harvard (−2.29%). The largest gains during this period have been made by Pennsylvania (54.34%), New York University (49.16+%), Missouri (47.09%), Ohio State (36%), Kansas (30.60+%) and Virginia (27.13%). Next come Cornell (24.20%), Michigan (24.18%) and Yale (24%), and these are followed by Minnesota (12.52%), Stanford (11.03%), Chicago (10.13%), Nebraska (9.65+%), Columbia (8.09%) and Wisconsin (7.46%). The enrollment at Princeton has remained stationary, the increase being one of only 0.52%. In the case of several institutions the large gains may be ascribed to the establishment of summer sessions.

According to the figures for 1905, the twenty-one universities included in the table ranked as follows: Harvard, Columbia, Chicago, Michigan, Minnesota, Cornell, Illinois, California, Yale, Pennsylvania, Wisconsin, Northwestern, Syracuse, Nebraska, Ohio State, Missouri, Leland Stanford, Indiana, Princeton, Virginia and Johns Hopkins. Comparing this with the order for 1906, we notice that for reasons to be discussed more in detail later, several changes have occurred. Harvard still has the largest registration, but is followed by Chicago, with Michigan third and Columbia fourth. Cornell has this year a larger registration than Minnesota, Pennsylvania and Yale have passed California, and the former has made other gains, the order this year—after Cornell—being Minnesota, Pennsylvania, Illinois, Yale, New York University, California, Wisconsin, Syracuse, Nebraska, Northwestern, Ohio State, Missouri, Kansas, Indiana, Princeton, Virginia and Johns Hopkins. Omitting the summer session registration, the order would be as follows: Harvard, Michigan, Columbia, Chicago, Pennsylvania, Cornell, Minnesota, Illinois, Yale, New York University, Syracuse, California, Wisconsin, Nebraska, Northwestern, Chicago, Ohio State, Missouri, Kansas, Stanford, Princeton, Indiana, Virginia and Johns Hopkins.

I desire at this place to express the hope that this article will not be interpreted by the reader as desiring in any way to place undue emphasis upon mere numbers as the most important factor in the development of a higher institution of learning; at the same time it will no doubt be of interest to notice where and how gains and losses have been experienced. No sensible person will regard the number of students in attendance at a university as the sole criterion of the advantages that one institution has over another.

Examining the different faculties, we notice that most of the institutions this year show an increase in enrollment in the academic department. This is true as far as men are concerned of every institution in the table, with the exception of Johns Hopkins and Wisconsin, and it is a rather remarkable fact, since several universities for a number of years have registered continual losses in their academic departments—these losses being in many cases due to corresponding gains in the scientific schools. A reaction has apparently set in in this direction, at least at a number of institu-

1902, are those for the close of the respective academic years.

tions. At Princeton, for example, the number of academic students has increased from 629 to 758, at Yale from 1,323 to 1,350, at Columbia from 557 to 606; whereas the number of scientific students at the same institutions has decreased from 624 to 484 in the case of Princeton, from 1,028 to 929 in the case of Yale and from 566 to 524 in the case of Columbia. At Harvard the discrepancy is even greater, the reason for which will be given later. The only other institution, in addition to those mentioned above, which shows a loss in the enrollment of the scientific schools is the University of California, and there the decrease is scarcely worthy of mention. The largest gain in the number of scientific students has been made by Illinois (from 880 to 1,020). As far as the number of women in academic courses is concerned, there has been a decrease at California and Stanford, while in all of the other institutions there has been a noticeable gain, particularly at Indiana, where the number has increased from 299 to 397; at Missouri, where a gain from 281 to 354 may be noted, and at Wisconsin, where the number of women has grown from 653 to 718.

The professional schools of law and medicine show a general falling off in attendance, appreciable gains in law having been made only by Chicago, Illinois, Indiana, Missouri, Northwestern, Syracuse, Virginia and Yale; and in medicine only by Indiana, Northwestern, Pennsylvania, Virginia and Yale. Strange to say, a number of the institutions show a decrease also in the enrollment in the graduate schools, appreciable gains having been registered only in the case of Cornell, Missouri, Virginia and Wisconsin. In pharmacy some of the institutions have made slight gains, while others show a loss. None of the institutions has lost veterinary students and the same holds true for forestry, although the gains are in no case large. The only dental schools that show an increase are those of Michigan and Pennsylvania. Architecture and music exhibit gains all along the line, with few exceptions. Minnesota and Ohio are the only institutions which have experienced a loss in students of agriculture. The divinity school at Harvard is practically as large as it was last year, while at Northwestern there is a loss of forty-six, at Yale of six and at Chicago of four students. Pedagogy shows a healthy increase in all but one of the institutions (Wisconsin).

Harvard still maintains the large lead that it has had for a number of years in the academic department. Inasmuch as a number of universities do not separate men from women in the academic statistics, it is difficult to determine the exact order for men only, but taking both men and women into consideration, the order would be Harvard, Michigan, Wisconsin, California, Leland Stanford, Minnesota, Yale, Chicago, Syracuse, Columbia. It will thus be seen that of the ten universities having an enrollment of over one thousand academic students, six are situated in the west. Cornell still leads in the number of scientific students, Michigan occupying second place, as was the case last year. Illinois comes third, followed by Yale, Wisconsin, Ohio State, California, Pennsylvania, Nebraska, Minnesota, Missouri and Columbia. Of the twelve institutions in the table with an enrollment of over five hundred scientific students, eight are located in the western states. New York University has the largest law school among the institutions in the list, with Michigan second, Harvard third and Minnesota fourth, Harvard being the only one of these four requiring a baccalaureate degree for admission. Pennsylvania has the largest medical school, with Northwestern second and Illinois third. As for the graduate schools, Columbia with an enrollment of 808 students

is by far the largest, Harvard with 437, Chicago with 358 and Yale with 357 following in the order named. Minnesota has by far the largest school of agriculture, while Pennsylvania leads in the students of architecture and Syracuse in those of art; Pennsylvania also has by far the largest school of dentistry, Northwestern leads in divinity and Yale in forestry (although some of the western institutions that include forestry under agriculture may actually have more forestry students than Yale); Syracuse has the largest school of music, Columbia the largest teachers' college, as well as the largest school of pharmacy, Ohio State the largest number of veterinary students. As far as the summer session of 1906 is concerned, Harvard and Columbia attracted more than one thousand students, Michigan, California, Indiana and Cornell following in the order named.

Taking up the different institutions included in the table in alphabetical order, we come first to the *University of California*.

The total number of undergraduates in the colleges of letters and science (including engineering) is 2,365, a gain of just three as compared with November 1, 1905. This is the largest number of undergraduates ever enrolled at this period of the academic year. The number of graduate students is 204, a loss of 67. This loss, however, is more apparent than real. Last year there was an unprecedented increase in the enrollment of graduate students, due to a new regulation which made it necessary for the graduates of 1905 who were applicants for the teachers' certificate to return to the University for at least a half-year of graduate study. For various reasons due to local conditions, this regulation was temporarily suspended for the class graduating in the summer of 1906. As a result very few of the graduates of last summer who were aiming at teachers' certificates have found it necessary to come back to the University for work in the graduate department. Hereafter, by action of the State board of education, high school teachers in California are not to be certificated on University credentials without a year of professional study following the baccalaureate degree.

Turning now to the professional colleges, in San Francisco, it will be noticed that the school of art has been temporarily discontinued. The building and the equipment of the school were totally destroyed by fire, though a few of the most valuable paintings in the gallery were rescued. As regards the loss of students in the other professional colleges, it is to be said that existing conditions in San Francisco are only in part responsible. Some of these colleges have been losing heavily during recent years and others have been barely holding their own. As was reported a year ago, the college of medicine has revised its admission requirements and demands, in addition to the equivalent of a four years' high school course, at least two years of properly selected university work. Eight or ten years ago the colleges of law, dentistry and pharmacy began to decline in number of students. During the last four years the enrollments of law and pharmacy have been practically stationary, and that in dentistry has continued to decline.

The principal additions to our equipment during 1905–6 were as follows: California Hall was completed and occupied. The administrative offices and the departments of history, economics, political science and education as well as the Bancroft library are housed in this building. The cost of the building, including equipment, was $292,000. In the men's gymnasium, new dressing rooms and showers were added at a cost of $30,000. In the women's gymnasium similar improvements were installed at a cost of $8,100. Temporary accommodations were provided for the departments of architecture and entomology at a combined cost of about $7,000. The university has established on the campus a students' infirmary. For the present, a wooden building upon the campus, formerly used as a dwelling-house, will be refitted and equipped as an infirmary and dispensary. For the maintenance of the infirmary the students here at Berkeley (colleges of letters and science, including engineering) are assessed two dollars and a half per half-year.

I have recently taken some pains to investigate the precise result of the San Francisco disaster upon the living accommodations of the students. It will help in understanding the questions at issue if the reader be reminded that the University of California has never maintained dormitories for the students; and that in 1894–95 only 51% of the students attending the colleges at Berkeley had their lodgings in Berkeley dur-

ing the university sessions. The remainder of the students found their lodgings in Oakland, San Francisco, and other nearby cities and towns. During the past twelve years the proportion of students lodging in Berkeley has increased steadily. In 1905–6, 78.6% of the undergraduate students and 75.4% of the graduate students had their lodgings in the University town. This great increase took place in spite of the fact that during these twelve years there were remarkable improvements in the means of interurban transportation in this vicinity. One might have supposed that this increased convenience in transportation would have induced a relatively larger number of students to live in Oakland or San Francisco or Alameda. Happily for the solidarity of university life and spirit, no such result has come about.

During the weeks following the earthquake and fire in April last, many thousands of people from San Francisco made their homes in the suburban towns, including Berkeley. For a time it seemed as if the students of the summer session would not be able to find lodgings in Berkeley. Even more strongly it was feared that accommodations for the 2,500 or more students who were to be registered during the regular session beginning in August, would be far from adequate. There were not wanting prophets who declared that it would be necessary for the students to live in tents or portable houses or to find rooms in Oakland or in settlements miles from the university. It is found, however, that the number of undergraduate students who have taken lodgings here in Berkeley this year is two per cent. greater than one year ago. As for the graduate students, the relative increase in Berkeley residents is 5.1%.

For the student who finds it necessary to economize, the cost of comfortable board and lodging in Berkeley is estimated to have increased not to exceed 10%, which increase is doubtless a temporary condition following the influx of San Francisco residents in and after April last. In many of the students' clubs and fraternities there has been no increase at all in living expenses.

Perhaps the most distinctive new feature of our university life during the past year has been the series of university symphony concerts, given in the Greek theater under the direction of Professor J. Frederick Wolle, who began his work in the university as professor of music in September, 1905. The first series of symphony concerts was begun in February and continued until May. The maximum attendance at any one performance reached 7,000 and at no time fell below 4,000. A second series is now being given and will be continued until late in November.

One of the most notable acquisitions of the past year is the Bancroft historical library of 50,000 volumes and 125,000 manuscripts, which has recently become the property of the university. Following the installation of this library, there has been established an academy of Pacific Coast history.

As for the *University of Chicago*, attention has been called to the fact that it is very difficult to compare the enrollment at Chicago with that of other institutions, on account of the four-quarter system in vogue at the former institution, during each or all of which a student may be in residence. To quote from the *Boston Evening Transcript* of October 20:

To enable an exact comparison of student attendance with that of other institutions having the customary three-quarter (equal to nine months) system, the attendance of students is usually reduced to the three-quarter system. A student in residence one-quarter equals one-third of a unit; in residence two-quarters equals two-thirds of a unit; in residence three-quarters equals one unit; and in residence four-quarters equals four-thirds of a unit. On this three-quarter basis the total enrollment for 1905–6 would be 3,205. The attendance during the summer quarter of 1906 was the largest in the history of Chicago summer quarters. The total registration for the first term of the summer of 1906 was 2,385, as against 1,999 in 1905, showing a gain of 19.3%. The attendance the second term was 1,583, as against 1,347 last year, a gain of 17.5%. The total number of different students for the entire summer of 1906 is 2,702; the total number of different students in both terms in 1905 was 2,293, showing a gain of 17.8%. Gains were distributed rather uniformly through the different schools and colleges, the largest percentage of gain, however, being in the divinity school; the college of education also showed a large increase in attendance. Of the total number of students in the different schools, 2,702, it may be added that 1,308 were men and 1,394 were women.

An inspection of the accompanying table will show that there has been a slight decrease in the total registration of *Columbia*

COMPARATIVE REGISTRATION FIGURES, NOVEMBER, 1906

Faculties	California	Chicago	Columbia	Cornell	Harvard	Illinois	Indiana	Johns Hopkins	Kansas	Leland Stanford, Jr.	Michigan	Minnesota	Missouri	Nebraska	New York	Northwestern	Ohio State	Pennsylvania	Princeton	Syracuse	Virginia	Wisconsin	Yale
College Arts, Men	566	702	606	731	2236	362	503	166	352	993	1528	515	371	290	263	368	268	307	755	1332	278	785	1350
College Arts, Women	929	647	398		399	395	397	—	364	476		871	354	669	152	479	266	—	—		—	718	—
Scientific Schools*	758	—	524	1544	242	1020	—	—	400	—	1197	615	577	619	194	—	770	636	484	407	118	782	929
Law	40	146	261	206	689	156	189	—	170	140	748	441	232	171	806	235	149	297	—	180	206	150	290
Medicine	54	145	352	336	296	488	65	264	107	—	423	196	65	132	448	500	—	594	—	150	133	—	155
Graduate Schools	204	358	808	212	437	139	—	156	50	49	96	53	107	95	222	40	41	285	110	65	43	302	357
Agriculture	112	—	—	256	43	361	—	—	—	—	—	763	108	175	—	—	180	—	—	—	—	143	—
Architecture	†	—	87	83	‖	130	—	—	—	—	—	—	—	—	—	—	17	136	—	45	—	—	—
Art	§	—	—	—	‖	13	—	—	16	—	—	—	—	59	—	—	—	—	—	77	—	—	40
Dentistry	35	—	—	—	65	85	—	—	—	—	168	162	—	—	—	325	—	356	—	—	—	—	—
Divinity	—	173	—	—	37	—	—	—	—	—	—	—	—	—	—	210	—	—	—	—	—	—	82
Forestry	**	—	—	—	‖	**	—	—	—	—	—	**	—	—	—	—	12	—	—	—	—	—	59
Music	†	—	26	—	‖	104	—	—	127	—	—	†	—	315	—	367	—	44	—	619	—	230	81
Pedagogy	†	178	726	—	‖	†	—	—	—	—	—	†	277	—	420	—	—	—	—	332	—	58	—
Pharmacy	45	—	254	—	—	171	—	—	80	—	92	71	—	—	—	120	66	—	—	—	—	34	—
Veterinary	—	—	—	88	—	**	—	—	—	—	—	—	—	—	36	—	125	111	—	—	—	—	—
Other Courses	—	247	—	248	—	42	—	32	—	—	—	—	—	200	544	131	62	1028	—	40	—	—	—
Deduct Double Registration.	—	(167)	(156)	(5)	(15)	—	(106)	—	(139)	(140)	(81)	—	(288)	(70)	(61)	(140)	(2)	—	—	(328)	(33)	(483)	(71)
Total	2743	2429	3886	3699	4429	3466	1048	618	1527	1518	4171	3687	1803	2655	3024	2635	1954	3794	1352	2919	745	2719	3272
Summer Session, 1906	707	2702	1041	642	1074	502	682	—	265	51	794	336	403	246	351	—	389	275	—	131	—	550	222
Deduct Double Registration.	(204)	(400)	(277)	(266)	(160)	(158)	(215)	—	(102)	(39)	(291)	(79)	(135)	(94)	(92)	(—)	(163)	(135)	—	(46)	—	(170)	(17)
Grand total, 1906	**3246**	**4731**	**4650**	**4075**	**5343**	**3810**	**1515**	**618**	**1690**	**1530**	**4674**	**3944**	**2071**	**2807**	**3283**	**2635**	**2180**	**3934**	**1352**	**3004**	**745**	**3099**	**3477**
" " 1905	3631	4557	4755	3871	5283	3635	1377	688	1706	1606	4521	3940	1887	2635	2912	2791	2057	3430	1361	2776	696	3083	3477
" " 1904	3738	4035	4833	3833	5392	3369	1206	740	1446	1424	4000	3886	1704	2728	2380	2856	1758	3027	1385	2452	691	3370	3008
" " 1903	3690	4146	4557	3438	6013	3239	1614	694	1319	1370	3926	3550	1540	2513	2177	2740	1710	2644	1434	2207	638	3221	2990
" " 1902	3676	4296	4302	3281	5468	—	1648	669	1294	1378	3764	3505	1408	2560	2201	2875	1603	2549	1345	2020	586	2884	2804
Officers	336	341	600	525	583	424	85	189	109	150	332	324	164	175	262	290	176	375	177	213	83	313	428

* Includes schools of chemistry, engineering, mining and related departments.

† Included in college statistics. § Temporarily discontinued.

‖ Not a separate school; courses taken by undergraduate and graduate students in college or scientific school and graduate school respectively.

** Included in agriculture.

University in comparison with last year, the decrease being due primarily to losses in several of the professional faculties. Columbia College shows a considerable increase over last year, the registration in this faculty having reached the high-water mark. There will no doubt be forty or fifty new students in February, which would bring the total registration at the close of the year to about 650, as against 589 for 1905–6. The entering class in the College is the largest in its history. Barnard College continues to show an increase and the figures will probably pass the 400 mark before the close of the year. The graduate faculties of political science, philosophy and pure science all have practically as many students as they had last year. This year for the first time the period of registration was reduced considerably, and as a result a number of students who did not report at the university in time failed to register altogether. The faculty of applied science again shows a decrease over the preceding year, although the number of new students is equal to that of last year. The requirements for advancement in this faculty have been increased considerably, and as a result a number of students who were unable to maintain their standing found it desirable to leave the institution. There has, accordingly, been a considerable improvement in the quality of the material, from the standpoint of scholarship. Under the faculty of fine arts, the school of architecture shows a decrease, due to the increased requirements for entrance—two years of college preparation—to the course leading to the degree. The law school shows a slight falling off this year, although the entering class is much larger than that of 1905. To the 92 students in the first-year class should be added 22 men from Columbia College enrolled also under the law faculty. The requirements for advancement in the law school have been strengthened considerably, and this accounts to a certain extent for the decrease in the second-year and third-year classes. All four classes of the medical school are classes that entered under the increased requirements, whereas last year there were only three such classes. The probabilities are, therefore, that the attendance at the medical school has reached its minimum this year, and from 1907 on there should be a gradual increase in the size of the entering class. Conditions at the College of Pharmacy are similar to those in the medical school, inasmuch as both of the present classes entered under the increased admission requirements, whereas last year one large class which had entered the year before the strengthened requirements became operative still remained. The increase in the number of graduate students at the College of Pharmacy is very encouraging. In spite of the fact that the first-year class at Teachers College has been abolished, this school shows an increase in primary registration of fifty-one over last year. In 1905 and the years preceding, Columbia and Barnard students who were also candidates for a diploma in teaching were included under Teachers College, but if the primary registration only is counted, it would show an increase from 667 in 1905 to 718 in 1906.

In connection with the development of material equipment, attention may be called to the fact that the Chapel and Hamilton Hall (a half-million-dollar building for the use of the undergraduate college for men) are ready for occupancy and that the corner-stone of Brooks Hall, a dormitory for Barnard College—the undergraduate department for women—has been laid. Among other important developments may be mentioned the establishment of a faculty of fine arts, comprising schools of architecture, design and music, the courses in design to be conducted in

cooperation with the National Academy of Design. In connection with the faculty of fine arts a course of study is offered for the first time leading to the degree of bachelor of music, and several students have become enrolled as candidates for this new degree. The Theodore Roosevelt professorship of American history and institutions in the University of Berlin and the Kaiser-Wilhelm professorship of German history and institutions at Columbia University were founded during the past year, Professor John W. Burgess, dean of the faculty of political science, being the first incumbent of the chair at Berlin, and Hermann Schumacher, of the University of Bonn, being the first incumbent of the Columbia chair. President Arthur T. Hadley, of Yale, has been appointed second Theodore Roosevelt professor. Columbia and Yale have cooperated in the establishment of courses in preparation for foreign service, and several Columbia students have become candidates this year for the consular certificate. The joint course of study is intended for the benefit of young men preparing for work in foreign countries, whether in the service of the United States government, in business enterprises, or as missionaries or scientific investigators. Barnard College has established a course leading to the degree of bachelor of science. The work of the first two years of the collegiate course of Teachers College will be transferred from Teachers College to Columbia College, for men, and to Barnard College, for women. In other words, a candidate for the B.S. degree in education spends the first two years at Columbia or Barnard College, respectively, and the last two years at Teachers College. In accordance with this arrangement the first-year class at Teachers College has been abolished this year; the second-year class will fall out in 1907.

At *Cornell University* there has been a noticeable gain in the academic department, as well as in the scientific schools. Under 'scientific schools' are included only those of mechanical engineering (with an enrollment of 1,084 students) and civil engineering (with an enrollment of 460 students), the students in chemistry being included under the academic department, and not under the scientific department. Practically all of the gain in the scientific schools has been made in the department of civil engineering, the enrollment of Sibley College (the department of mechanical engineering) having remained stationary. The schools of law and medicine show a decrease, the graduate schools and the school of agriculture an increase, while the school of architecture and the veterinary college have practically the same enrollment as in 1905. The summer session shows a gain from 619 to 642, although the number of summer-session students who returned for work in the fall has decreased from 312 to 266.

The total attendance at *Harvard University* shows an increase, to which the academic department particularly has contributed. The law school and the graduate schools, as well as the school of dentistry, show a falling off, while divinity has the same enrollment as last year. Medicine shows an increase of six.

The increase in Harvard College (from 1,898 to 2,236) and the noticeable reduction of the Lawrence Scientific School (from 507 to 242) is due to changes of classification and also to new plans of study adopted by scientific undergraduates in connection with the establishment this year of the new graduate school of applied science. This year students formerly registered in the Lawrence scientific school were given their choice of remaining in the four-years prescribed programs leading to the degree of B.S. in a designated field of study, such as mining engineering or architecture, or of shifting their registration to Harvard College, there to receive the plain degree of B.S. on an elective course of study. Those who have chosen the latter alternative will in many cases take a more liberal course of study than would have been open to them in the Law-

rence scientific school, postponing their advanced professional work until they enter the graduate school of applied science, where they will spend two or three years. Owing to these changes, the body of students corresponding to that which has heretofore been catalogued as scientific, that is, in the sense that they are actually working toward a professional degree in science, can only be found by adding to the students in the old undergraduate four-year programs in science, all those students now in Harvard College who, while candidates for the elective B.S. or the A.B., are continually pursuing such elementary or introductory studies in science as shall most effectively advance their subsequent candidacy for one of the degrees of the graduate school of applied science.

To extricate these undergraduates so as to furnish a satisfactory comparison with last year is so complicated and futile a task, that it seems best to let the category 'scientific schools' stand with its apparently heavy loss. It may be predicted that the undergraduate portion of this category (212 in 1906) will disappear in a few years, while the graduate portion (30 in 1906) will slowly increase, until the scientific professional branches are completely established at Harvard on the graduate level on which its schools of divinity, law and medicine already stand.

As among the most important events of this period at Harvard should be mentioned the establishment of the medical school in its five great white marble buildings on land already arranged for the neighboring occupancy of a group of important hospitals—an equipment which is noteworthy not only for its present adaptation to medical instruction and research, but also for its generous and minutely elaborated allowances for future growth. The other important addition to Harvard's equipment of buildings is the new building for the law school, to be called Langdell Hall, in honor of the late dean of the school.

In the financial administration of the University an important feature this year is the establishment in the departments within the faculty of art and sciences of a new system of tuition fees, whereby each student is obliged to pay in addition to the lump sum of one hundred and fifty dollars a year, twenty dollars for each course beyond the minimum number required for a full year's work.

Harvard is offering this year for the first time a considerable group of afternoon and Saturday courses for teachers. The students thus enrolled are not counted in the table.

At the *University of Illinois* there has again been a good increase in the grand total, but the increase aside from the summer session is also quite marked. Gains have been made in every department, with the exception of medicine, dentistry and the graduate schools, the largest increase having been made (as was the case last year) by the scientific schools. The 42 students mentioned under 'other courses' are enrolled in the library school, which offers a five-year course leading to the degree of B.L.S.

The enrollment in *Indiana University* shows a satisfactory increase all along the line, the growth being noticeable especially in the academic department for women, where the enrollment has increased from 299 to 397, and in the school of medicine, which has increased from 26 to 65 students.

At *Johns Hopkins University* there has been a decrease in enrollment, the college registration having dropped from 188 to 166, that in medicine from 293 to 264, that in the graduate schools from 160 to 156, and in 'special courses for physicians' from 47 to 32.

As the figures of the *University of Kansas* for 1902 to 1905 are those for the close of the respective academic years, no accurate comparisons can be made. No doubt the final figures for 1906–7 will show a gain over last year. The large increase in 1905 was due to the merging of the university medical school and three medical schools in Kansas City, Mo. This university is at present erecting a $100,000 gymnasium, which is to be occupied in the fall of 1907.

Leland Stanford University shows a slight decrease, the reason for which is self-evident. This decrease has made itself felt in all departments but law, which has remained stationary. It should be noted in connection with the statistics of this university that the number of women is lim-

ited to 500, and that in future the number of men also will be strictly limited, probably on the following basis; about 500 in the general courses, 500 in the engineering and law courses and an unlimited number of graduate students.

The University of Michigan shows no such remarkable gains in attendance as was perceived last year at the same date; nevertheless, there has been a considerable increase everywhere except in the departments of law and homeopathic medicine, and in the graduate schools. The decrease in the professional schools mentioned may be due partly to the increased requirements for admission. While the number of women remains approximately the same, the number enrolled as first-year students is smaller and those coming with advanced credits from other colleges correspondingly larger. The attendance of women by departments is as follows: academic 655, medicine 22, homeopathic medicine 10, dentistry 5, pharmacy 2, engineering 1, graduate schools 25. The inability to secure absolutely accurate returns from the University of Michigan has somewhat marred the value of the figures from this institution.

The *University of Minnesota* shows a slight loss over last year in the fall registration, although an increase in the enrollment of the summer school brings the grand total four in advance of last year's figures.

The total of 3,944 does not show the complete registration for the year, as the law school is conducted on a term system, and students will enter late for work of the different terms. Also at the beginning of the second semester we shall have from fifty to one hundred students entering the various departments. The graduate registration will also be increased somewhat before the year is over. The other departments will remain almost exactly as stated. A conservative estimate therefore of the total enrollment for the current year will be something over 4,000, between 4,000 and 4,100. A comparison of the statistics of this year with those of last shows a slight increase in nearly all departments except the graduate school. The decrease there is due undoubtedly to the establishment of a graduate school with a dean at its head and a regular system of fees, and more rigid requirements regarding the registration of graduate students. The matter of conducting graduate work has been definitely systematized and the fees increased from $10 a year to $10 a semester. This will explain in part the difference in the two registrations. A falling off in the scientific schools, due to the increased standard for admission to the engineering college, was expected, but did not take place. On the contrary, there was an increase from 576 to 615. Entrance examinations are required for one year of elementary algebra, one half-year of higher algebra, one year of plain geometry and one half-year of solid geometry of all students entering this college, regardless of the standard of the schools from which they come. The college of medicine and surgery has increased its entrance requirements from one year to two years. This new requirement is to go into effect in 1907–8. A college of education has just been established with a dean at its head, but because of the newness of the organization, students are classed this year with the college of science, literature and the arts. A slight decrease is expected in the college of dentistry due to the increase in annual fees from $100 to $150. The college has all the students it can take care of and no more would be admitted.

There is a slight decrease in the number of women in the college of science, literature and the arts, and quite a large increase in the number of men. This is explained in two ways. First, the rigid requirements in mathematics have turned some away from the college of engineering and they perforce enter the college of arts, where the bars are not so high. Secondly, the college of science, literature and the arts has made a slight change in the entrance requirements, which really lowers its standard for admission. Heretofore students were required to present a certificate of graduation from an accredited high school and in addition were held for fifteen year-credits. As the choice of these fifteen year-credits was somewhat limited, it was found that students taking the manual training and commercial courses in the high schools had not the proper credits for admission to the college of science, literature

and the arts, whereas those taking the general, scientific, or Latin courses were admitted without question. As the regulation now stands, students are admitted from any accredited school, provided the certificate of graduation shows the completion of four years of English and two years of mathematics, the other subjects being optional. This would naturally lead to an increase in the number of men in the college of science, literature and the arts.

The attendance at the *University of Missouri* continues to increase, the total gain in the fall registration (exclusive of the summer session) being no less than 178 this year, as against a gain of 89 last year. This gain is distributed over all the departments, with the exception of medicine.

In the department of medicine there has been an increase of two years work in the entrance requirements. For the session of 1905–6, three years of high school work was required. For the present session, students must have completed one year's college work in specified subjects in addition to the four years' high school work required for entrance to the college. This increase in entrance requirements is in large part responsible for the decrease in enrollment in the department of medicine. For the past eighteen months there has been considerable agitation for the removal of the work of the two last years in medicine to St. Louis or Kansas City. While no definite decision has been made, as yet, it is probable that the uncertainty contributed in some measure to the loss in this department.

The large increase in pedagogy is a continuation of the movement which commenced in 1904, as a result of the organization of the teachers college and the strengthening of the instruction in this department.

The increase in the academic department (college of arts) is partly due to the increased tendency of students to take the A.B. degree before beginning professional work. This has been promoted by the establishment of combined six-year courses. The increase in the entrance requirements to the department of medicine, referred to above, has also affected the increase in enrollment in the academic department. The large increase in the number of women in the university, too, has affected the enrollment in the academic department and teachers college. This marked increase commenced in 1903 with the opening of Read Hall, a dormitory for women. Of the 2,071 students, 1,483 are men and 588 are women as compared with 1,388 and 499 respectively, in 1905, at the same date.

The *University of Nebraska* shows an increase in every faculty, with the exception of law, and there has also been an increase in the summer session. The 200 students mentioned under 'other courses' represent the estimated enrollment in the short course in agriculture, which begins on January 2. It is rather difficult to make accurate comparisons for the earlier years, inasmuch as the figures for 1902, 1903 and 1904 represent the final figures for the respective academic years, while the 1905 figure represents the enrollment as of November 1 of that year. No doubt the total enrollment for the academic year 1906–7 will reach 2,900.

As *New York University* was not included in the table last year, no comparisons of individual faculties can be made, but there has been a considerable gain in the total over 1905. Among the changes which may have affected the enrollment should be mentioned the increase in the tuition fee in the schools of applied science from $100 to $125; the increase of the fee in the law school from $100 to $130, and the raising of the requirements for the Ph.D. degree in the graduate school from six to eight courses; the addition of a $5 matriculation fee, and the requirement of a seven-years' degree from graduates of the New York City Normal College. In the veterinary college, the entrance requirements have been raised from thirty-six regents counts to forty-eight.

Northwestern University shows a loss in attendance, which is partly due to the fact that there were no summer-session students in 1906, while there were 194 in 1905, although of the latter 152 returned for work in the fall. The gains in the college and the schools of law, medicine, music and oratory, are not sufficient to offset the losses

in the graduate school and the departments of dentistry, divinity and pharmacy. The students enrolled under 'other courses' are registered in the department of oratory.

Ohio State University shows an increase over last year, the only departments showing a loss being those of agriculture and forestry. Of the 180 students in the school of agriculture, 51 are enrolled in the so-called short course, which is two years in length. Of the 62 students under 'other courses,' 15 are registered in the so-called short course in domestic science, which is also two years in length.

The *University of Pennsylvania* has made considerable gains, especially in the scientific schools, and the schools of medicine, architecture, dentistry and veterinary medicine. The academic department and the graduate schools have remained stationary, while the department of law shows a falling off. The greatest increase is to be found under 'other courses,' namely, one from 621 to 1,028. The students given here are enrolled in the courses in finance and commerce, both day and evening, and in the teachers' courses. Some of the latter no doubt fall in the category of extension students, which are omitted in the case of Harvard, Columbia and other institutions, and should therefore not be included here, but it was impossible to ascertain in time just how many of the students enrolled in the courses for teachers should be omitted. The largest increase was in the summer school, which grew from 214 in 1905 to 275 in 1906. The increase in the Towne scientific school is to be found chiefly in the departments of mechanical and electrical engineering. New requirements have been adopted for admission to the law school which exclude all but college graduates, unless the applicants are more than twenty years old, the law school having heretofore admitted all applicants who passed the college entrance examination, irrespective of age. A splendidly equipped engineering building has been occupied for the first time this fall.

The enrollment at *Princeton University* shows a slight decrease over that of 1905. As has already been pointed out, the academic department shows a gain of over 100, while the scientific schools show a similar decrease, the registration in the graduate schools having remained stationary. The entering class is not as large as it was last year, the loss being attributed to increased requirements and the more rigid enforcement of the same. There has been a marked increase in the number of students entering Princeton on advanced standing from other colleges, although this increase does not quite offset the loss in the entering class.

At *Syracuse University* the only department that shows a decrease is that of art, the schools of medicine, architecture and music, as well as the graduate schools, having remained stationary, while the remaining departments show considerable gains, the academic enrollment having increased from 1,213 to 1,332.

The new buildings at Syracuse University now in process of erection and nearing completion are: (1) The general library, the gift of Mr. Andrew Carnegie, with stack accommodations for three-quarters of a million volumes, a reading room to accommodate three hundred students, and twenty seminar rooms, besides ample accommodations in the first story for the school of library economy. (2) A hall of natural history, erected at a cost of about $200,000. (3) A $100,000 mechanical laboratory for the engineering courses in applied science. (4) A dormitory for men, with capacity for two hundred; cost about $150,000. (5) A chemical laboratory. (6) Fourteen acres of land adjoining the campus and a large structure known for many years as the Castle, the proportions of which are finely adapted to the work of the teachers college have been purchased. (7) A stadium is being built with a seating capacity of about twenty thousand people; it is an excavation and after the Athenian or ancient Syracuse style. The campus of Syracuse to-day comprises ninety-eight acres. The total number of educational buildings is twenty-one.

The *University of Virginia* shows a considerable increase all along the line, and its enrollment this year is the largest in the history of the institution. The department of engineering began with 58 students in the academic year of 1903–4, there were 88 the following year and 118 at the close of the academic year 1905–6. The final registration for this year will no doubt pass 125. Among recent material improvements and additions may be mentioned the repairing and better equipment of the anatomy hall; the provision and equipping of a histological laboratory; further equipment of bacteriological and pathological laboratory; provision and equipment of a laboratory for physiology and physiological chemistry; provision and equipment of an additional chemical laboratory; a residence for the president of the university; the university commons, and a north wing to the hospital.

The *University of Wisconsin* shows a slight decrease in the fall figures, which, however, is more than offset by the increase in the enrollment of the summer session. The chief decrease has been experienced in the number of men in the academic department, all of the other departments, with the exception of pedagogy, showing a gain or having remained stationary. Attention should be called to the fact that graduate students are assigned to the different colleges in which their work principally lies, the total number of graduate students indicated under the caption of 'graduate schools' having been included in the deduction made for double registration. The entrance requirements for admission to the college of engineering were increased this year, more mathematics being demanded than heretofore. No short-course students have been included in the summary. If the students enrolled in the winter course in dairying and in the short course in agriculture were included, it would increase the enrollment at this university considerably.

The fall registration at *Yale University* still continues to increase, although the grand total (on account of a decrease in the number of summer-session students) is exactly the same as it was last year. The departments that show a loss in their registration are those of art, divinity and music, and the graduate schools, although the decrease is in no case large. A striking fact is the slow but regular gain of the academic department during the last five years.

RUDOLF TOMBO, JR.,
Registrar.

COLUMBIA UNIVERSITY.

SCIENTIFIC BOOKS.

An Outline of the Theory of Organic Evolution, with a Description of some of the Phenomena which it explains. Second Edition, revised. By MAYNARD M. METCALF. New York, The Macmillan Company. 1906. 8vo.

Of popular treatises on the doctrine of organic evolution there is a goodly number, but in none is there such clearness in exposition combined with such abundance of well-chosen and well reproduced illustrations as is to be found in Professor Metcalf's volume. This is a sufficient explanation of early appearance of a second edition of the book, which, the author informs us, is 'not intended for biologists, but rather for those who would like a brief introductory outline' of the theory of evolution. To all teachers of biology, however, as well as to the general public, the book will be welcome, especially on account of the numerous excellent figures which serve to illustrate, almost without description, many of the facts upon which the theory is based. Especially valuable is the series of seventeen plates, several of them colored, illustrating variation in domestic animals and cultivated plants, and especial mention may also be made of the beautiful examples of color printing shown in the figures illustrating color in animals. The extent to which the author has relied on illustrations for the exposition of his subject may be gathered from the fact that

no less than one hundred plates and forty-six text-figures accompany the one hundred and ninety-nine pages which compose the text.

The book is divided into two parts, the first of which treats of the theory, briefly discussing inheritance, variation, the struggle for existence, mutation, artificial selection, sexual selection, segregation, and the inheritance of parental modifications. The second part considers the phenomena explained by the theory, under the headings of comparative anatomy, embryology, paleontology, geographical distribution, and the color of animals, and concludes with a chapter on the evolution of man and some general considerations.

Within the brief limits to which the text is confined a consideration of all the factors which have been proposed or recognized as contributing to organic evolution is impossible. The difficulty before the author of such a book is to decide what to omit, and, on the whole, Professor Metcalf may be said to have grappled successfully with his difficulty. But little extra space, however, would have been required for a presentation of the theory of orthogenesis, and a brief account of the observations of Bumpus on sparrows and Weldon on Carcinus would have given a more definite meaning to the term 'selection-value.' Further, it may be remarked, that in the list of works on evolution given in an appendix no mention is made of Haeckel's 'Evolution of Man,' which surely deserves a place in such a list, even if Plate's admirable treatise be excluded, because as yet un-Englished.

These omissions are, however, but minor faults, if faults they may be called. More deserving of criticism is the title of the book, which is really an exposition of the theory of natural selection. In the popular mind the theories of evolution and natural selection are so intimately associated that recent criticisms of the latter and suggestions of various additional factors of evolution have led, in many cases, to the belief that the doctrine of evolution is tottering on its base and is well-nigh, if not entirely, discredited. Nor is the confusion of the two theories altogether confined to the popular mind, and anything which tends to foster it is to be deprecated. Whether natural selection in the Darwinian sense stands or falls, the doctrine of evolution remains unshaken.

And this is not the only confusion that exists with regard to the theory. It has been discussed both as a factor in the origin of species and as a factor in the preservation of species, or rather of adaptations which may or may not be specific. In its former application it is certainly open to criticism; in the latter, and stated as the theory of the elimination of the unfit, it is almost self-evident.

Professor Metcalf's book, unfortunately, tends to perpetuate these confusions; but even with this fault it is a book worth reading and well deserves its success.

J. P. McM.

The Microscopy of Vegetable Foods, with special reference to the detection of adulteration and the diagnosis of mixtures. By Andrew L. Winton, Ph.D., in charge of the Analytical Laboratory of the Connecticut Agricultural Experiment Station, Instructor in Proximate Organic Analysis in the Sheffield Scientific School of Yale University. With the collaboration of Dr. Josef Moeller, Professor of Pharmacology, and Head of the Pharmacological Institute of the University of Graz. With 589 illustrations. New York, John Wiley and Sons; London, Chapman and Hall, Limited.

This work is a very timely one in view of the fact that the pure-food bill will go into effect on January 1, 1907. Owing to the importance of the subject, whether from the point of view of the manufacturer or that of the consumer, it seems rather strange that until now so few good working books have appeared on this subject. While there are several good books by German authors on the subject of the microscopical examination of foods, there is nothing that can compare with the volume at hand.

Both Doctors Winton and Moeller are well known for their valuable researches on the subject of food products. Dr. Winton is a former student of the eminent pharmacognosist, Professor Moeller, and it is rather unique to find a student associated with his

teacher in this way, each contributing his part to a common work, and the whole appearing almost simultaneously in two languages. In the American edition it is Dr. Winton with the collaboration of Professor Moeller, while in the German edition it is Professor Moeller with the collaboration of Dr. Winton. This is a beautiful acknowledgment of their confidence in each other, and we have seldom seen the work of two men that is so much alike in both drawings and descriptions as in this instance.

The work is divided into ten parts, as follows: (1) Equipment, methods and general principles; (2) grain, its products and impurities; (3) oil seeds and oil cakes; (4) legumes; (5) nuts; (6) fruit and fruit products; (7) vegetables; (8) alkaloidal products and their substitutes; (9) spices and condiments; (10) commercial starches. The work contains in addition a general bibliography, a useful glossary and a good index.

A careful examination of this book of Winton and Moeller's shows that in order to carry on analyses of vegetable food products successfully it is essential for the analyst to have special botanical training, and that with the knowledge gained by this training the determination of purity and the detection of adulterants is reduced to a degree of scientific accuracy hardly possible in any other kind of analytical work. The teachers of chemistry and those in the biological departments of colleges and technical schools should cooperate in arranging courses which would not only qualify their students to examine vegetable products, but also enable them to devise methods for their manufacture.

This book could be used as a text-book, and will be found an invaluable reference book for the food analyst, the agricultural chemist, the pharmacist and others engaged in the examination of foods, as well as the physician who may be called upon to identify vegetable substances in stomach contents and feces.

HENRY KRAEMER.

Essentials of Crystallography. By EDWARD HENRY KRAUS, Ph.D., Junior Professor of Mineralogy in the University of Michigan. Ann Arbor, Mich. 1906. Pp. 162; 427 figures.

Unlike some related sciences crystallography is not over-burdened with texts, certainly not with those printed in the English language. The appearance, therefore, of a new crystallography is an event of considerable importance to teachers of mineralogy. The author of 'Essentials of Crystallography' was trained in the laboratory of Professor Paul v. Groth, of Munich, and in the two brief years that he has been in the faculty of the University of Michigan, has developed a flourishing department which already requires the services of a professor, an instructor and two assistants.

Most writers of books upon crystallography appear to go out from the idea that the subject is adapted to study by a very limited number of persons, and those only who are to become thorough masters of the subject and advance it through original research upon general lines. Thus the texts published in England have laid stress upon mathematical theorems rather than upon the symmetry of crystals. The great development of organic chemistry in recent years, and the prominence which crystal symmetry and habit have acquired as means for identifying chemical compounds, has demonstrated that crystallography is a necessary part of the training of chemists as well as of mineralogists and geologists. For such students much must be eliminated from consideration in order that essential facts may be grasped, and the course be given a practical value.

The requirements of such students were singularly well met by the 'Elements of Crystallography' of the late George Huntington Williams, as was, perhaps, shown by the rather extensive use of the book by American teachers. Since the profound changes brought about by the acceptance and introduction of Gadolin's thirty-two classes of crystals, Williams's work has been no longer serviceable as a text, and its place has not been filled by any later work.

Professor Kraus apparently makes the fundamental assumption that crystallography can not be learned outside of a crystallographical laboratory or without the guidance of a

teacher. He has thus been able to cut down his text to 160 pages and to offer his book for sale at a price corresponding to one cent per page. The large number of figures for a book of such small compass, shows that so far as possible the training is to be through the eye, and the identification of models and crystals made easy.

The order of treatment is by systems and their subordinate classes, beginning with the forms of highest symmetry; and the holohedrism, hemihedrism and tetartohedrism of forms is indicated, though made secondary. The systems of nomenclature of Weiss, Naumann and Miller are used side by side. The relationships of the forms belonging to classes within the same system are indicated by tables and diagrams, in which the apparently holohedral forms and those which bring out in their development the real symmetry of the group, are sharply differentiated.

The six pages devoted to compound crystals will seem to many inadequate, in view of the great prominence of twins in the case of a large number of species. Not the least valuable part of the work is an appendix giving a tabular classification, which shows the symmetry elements and the simple forms of each of the thirty-two classes of crystals.

William Herbert Hobbs.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for November contains three long papers: 'Variation in the Number of Seeds of the (American) Lotus,' by Raymond Pearl; 'The Causes of Extinction of Mammalia,' by Henry F. Osborn; and 'A Preliminary Study of the Finer Structure of Arcella,' by Joseph A. Cushman and William P. Henderson. Professor Osborn's paper, which is to be continued, discusses seriatim the external causes, such as variations in climate, increasing cold, heat or moisture, with their concomitant changes in plant and insect life; and the relations of plants and insects to mammals, with their bearing on extinction. Discussion is desired and criticisms and suggestions will be welcomed. Messrs. Cushman and Henderson show that the generally accepted idea of the structure of the test of *Arcella* is incorrect, and that the framework instead of consisting of simple hexagons, touching one another at their sides, consist of hexagons touching at their angles and thus leaving triangular interspaces which permit the interpolation of new columns of hexagons as growth proceeds. There are many ichthyological notes, while those relating to botanical publications are, as usual, numerous.

The American Museum Journal for October is termed the Sponge Number, the principal article being 'A Guide to the Sponge Alcove in the American Museum of Natural History,' by Roy W. Miner. This is well written and well illustrated. Incidentally, it may be remarked that it is very difficult to find in any text-book a consecutive definition of a sponge; we are told all about the structure and embryology of sponges, but what a sponge really is and its position in the animal kingdom has to be gathered by much reading. The *Journal* contains brief reports of several of the Museum expeditions, including those to Tahiti, Colorado, North Carolina and East Africa.

The Museum News of the Brooklyn Institute for December has articles dealing with 'The Question of Common Names' and, in connection with a recently installed group, 'The Golden Eagle, its Haunts and Habits.' It is noted that the museum has acquired the Ward collection of sponges and corals, the former containing 150 specimens of siliceous sponges and 660 of horny sponges; the latter comprising 234 species of corals. The collection of sponges was brought together by the late Professor Henry A. Ward and is extremely valuable from both the scientific and the popular standpoint, comprising as it does selected specimens from many years of collecting. The leading article of the Children's Museum section, under the title of 'General and Mrs. Green,' deals with two bullfrogs that have lived in the museum for four years.

SOCIETIES AND ACADEMIES.

THE AMERICAN PHYSICAL SOCIETY.

The fall meeting of the Physical Society was held in Chicago on December 1. In the absence of President Barus, Past-president A.

A. Michelson occupied the chair. The meeting was well attended, members coming not only from the vicinity of Chicago, but also from points in Kansas, Iowa, New York and Nebraska, more than five hundred miles distant.

A resolution was adopted urging upon the council the desirability of holding a regular yearly meeting in Chicago or some other suitable point in the middle west.

The following papers were presented:

John E. Almy, University of Nebraska: 'Spark Discharges in Gases and Vapors.'

Bruce V. Hill, University of Kansas: 'On the Magnetic Behavior of Certain Alloys of Nickel.'

Frederick E. Kester, Ohio State University: 'An Experimental Gyroscope for Quantitative Work.'

R. A. Millikan and George Winchester, University of Chicago: 'Upon the Discharge of Electrons from Ordinary Metals under the Influence of Ultra-violet Light.'

A. B. Porter, Chicago: 'An Inanimate Demon.'

A. B. Porter, Chicago: 'On Multiple Crossed Gratings.'

A. A. Michelson, University of Chicago: 'On the Ruling of Diffraction Gratings.'

H. G. Gale, University of Chicago: 'The Effect of Temperature on Metallic Spectra.'

C. E. Mendenhall and L. R. Ingersoll, University of Wisconsin: 'The Radiation Constants and Temperature of the Nernst Glower.'

K. E. Guthe and C. L. von Ende, University of Iowa: 'Standard Cells.'

F. L. Bishop, Bradley Polytechnic Institute: 'Heat of Dilution.'

Lawrence E. Gurney, University of Idaho: 'The Viscosity of Water at Low Rates of Shear.' Introduced by A. A. Michelson.

Frederick E. Kester, Ohio State University: 'The Bridge Method for Comparison of Condensers.'

A. H. Taylor, University of Wisconsin: 'A Method for the Determination of Electrolytic Resistance and Capacity.'

C. F. Lorenz, Johns Hopkins University: 'On the Effects of the Electrical Discharge on the Acetylene Flame.'

Wm. R. Blair, University of Chicago: 'Change of Phase due to the Passage of Electric Waves Through Thin Films and the Index of Refraction of Water for Such Waves.'

Wm. W. Coblentz, Bureau of Standards, Washington: 'The Temperature of the Moon.' (By Title.)

F. W. Very: 'The Temperature of the Moon.' (By Title.)

Ernest Merritt, Cornell University: 'Note on the Fluorescence of Sodium Vapor.'

H. V. McCoy and W. H. Ross, University of Chicago: 'The Relation between Uranium and Radium.'

Ernest Merritt,
Secretary.

DISCUSSION AND CORRESPONDENCE.

'ELIMINATION' IN FIXING GENOTYPES.

To the Editor of Science: The valuable article on this subject by Mr. Witmer Stone, in Science for November 2, contains a list of twenty-five systematists to whom certain problems were submitted. The names given are all those of well-known workers in the United States, and I wondered why Mr. Stone had made no attempt to obtain the opinions of his foreign colleagues. The reason was found in the penultimate paragraph: "Elimination has never been practised in Europe and does not seem to be understood by foreign writers." Possibly it did not occur to Mr. Stone that, if foreign writers had never practised elimination, it might have been because they had always shared his unfavorable opinion of the method, and not from any lack of intelligence. The statement, however, is incorrect; at least some of us in the British Museum, who assuredly did not get our training in systematic zoology from any other part of the world, have always practised elimination when other principles, such as the fixing of a genotype by the author or the first reviser, did not intervene. I will accept Mr. Stone's assertion that we do not seem (to him) to understand the matter; but I hope to convince him that some of us do understand it at least as well as the majority of those who have replied to his questions. While reading his article I jotted down in the margin my answer to each question, and finished doing so before turning the page. The result was as follows: My answers to questions I, II, III, IV*b*, V*a*, V*b*, V*c*, VI, VII*a*, VII*b*, VIII*a*, that is to eleven out of thirteen questions, were in agreement with the majority. In VIII*b* there was no majority,

since 4 say 'sp. 4' and 4 say 'sp. 3'; I agree with the latter. In IVa, 7 say 1855, 8 say 1880, one says date when synonymy was first recognized: the answer depends on the meaning of the word 'removed'; if this be taken literally, the answer is 'either 1880 or any previous date when the synonymy may have been recognized'; but if we regard the spirit of the question, it will be obvious that when a genus is once established it includes all species congeneric with its genotype whether they have been 'removed' to it or no—therefore my answer was 1855. Ambiguity in this question may have been the cause of the equality of votes. In the case of question VI, the pronounced majority is perhaps due to ambiguity in the answer: what I say is that the reviser can not select as genotype of an early genus any species that is already genotype of a subsequent genus, so long as there remains any species free among the originally included species; therefore I wrote 'yes' to the first clause of the question, and 'no' to its second clause.

Adding my replies to those given, it appears that I agree with the majority, usually a large absolute majority, in twelve out of the thirteen cases, and that the thirteenth case, which is ambiguous, is a draw. After this Mr. Stone will probably admit that the method is understood by me, and he will perhaps accept my assurance that I am only an insignificant unit among a fairly large number of old-world writers of similar views and all provided with the small amount of intelligence required.

The considerable agreement attained by those who have answered his questions should prevent the wholesale condemnation of the elimination method; but it would add interest to the figures if we were told whether the minority was generally composed of the same writers. If so, they would probably yield only to *force majeure;* but if not, they might be brought into line by gentle argument.

Mr. Stone makes out a very strong case for the 'first species' method; but is he correct in saying that it 'can lead to but one result'? Would he kindly refer to *Annals and Mag. Nat. Hist.* (2), XVI., pp. 95, 96, and say what, on that method, is the genotype of *Hemipedina?*

F. A. BATHER.

LONDON, ENGLAND,
November 12, 1906.

SPECIAL ARTICLES.

POLYEMBRYONY AND THE FIXING OF SEX.

NATURALISTS have long been familiar with certain curious and unexplained phenomena connected with the life histories of certain parasitic hymenopterous insects of the family Chalcididæ. DeGeer in 1752 figured a minute black species with dirty-white wings, which he reared from *minute cocoons* attached together side by side in the larva of one of the pear-leaf miners. Westwood, in the second volume of his Introduction, says of this insect: "The figure has somewhat the air of *Encyrtus;* but the pupæ are naked in that genus."

In the *American Naturalist* for February, 1882, in the second installment of an article entitled 'On some Curious Methods of Pupation among the Chalcididæ,' the writer described a precisely similar object found in the mines of an oak-leaf miner, *Lithocolletis fitchella,* at Washington and bred from it a number of specimens of an encyrtid of the genus *Copidosoma.* He further described somewhat similar cocoon-like formations within the larval skin of the pine-leaf miner, *Gelechia pinifoliella;* also in the skin of the larva of the twig borer, *Anarsia lineatella,* in the larva val skin of the pine-leaf miner, *Gelechia pinisolidaginis*), and finally described at some length the strange habits of a congeneric parasite which attacks the larva of *Plusia brassicæ.* The latter was described as follows:

> The *Plusia* larva, up to the time of commencing to spin, appeared quite healthy, although perhaps a little sluggish. Then suddenly its torpor increased, and through the semitransparent skin were seen hundreds of small white parasitic larvæ. In two days at the most the host was dead, having perhaps partially finished its cocoon, while its entire body was completely packed with the parasitic larvæ or pupæ, each surrounded by a cocoon-like cell. A cross-section of the host at this stage showed a regular honeycombed structure. After remaining in the pupal state not longer than twenty days, the chalcidids com-

menced to emerge by the hundreds. My friend, Mr. Pergande, took the trouble to count the parasites which actually issued from one *Plusia* larva, and, to our utter astonishment, the number reached 2,528. An interesting problem now presents itself as to the nature of the cocoon-like cell surrounding each chalcidid pupa in all these different hosts from *Lithocolletis* up to *Plusia*. In the first place it is no silken cocoon, as is readily shown by the microscopic structure. Neither is it a membrane secreted in the general surface of the chalcidid's body, for but a single wall exists between two adjoining pupæ. For the same reason it is not the loosened last larval skin of the parasite. But one hypothesis remains, and that is that it is a morbid or adventitious tissue of the host. * * *

The same phenomenon was referred to by the writer in *Insect Life*, Vol. IV., p. 193, with illustrations, and again in his paper on the 'Biology of the Hymenopterous Insects of the Family Chalcididæ,' in the *Proceedings of the U. S. National Museum*, Vol. XIV., p. 582 (1892). In the latter paper the statement was made that in no case had it been possible to count over 160 eggs in the ovaries of a single *Copidosoma*, and that the number of parasites issuing from a single *Plusia*, therefore, was puzzling and only to be explained on the ground that several females oviposited in a single larva at the same time, as all larvæ develop together, and transform together, and issue nearly together.

In the meantime E. Bugnion, in a most interesting and important paper entitled 'Recherches sur le Développement Postembryonnaire, l'Anatomie et les Moeurs de l'Encyrtus fuscicollis' (*Recueil Zool. Suisse*, Vol. V., pp. 435–536, 1891) had studied with care one of these interesting insects parasitic upon a little Tineid larva, *Hyponomeuta cognatella*, and he found that if one opens the little caterpillar at the end of April or the first half of May, almost always, or at least with some of them, the embryos of the *Encyrtus* (or *Copidosoma*) will be found associated together in the form of chains or strings. These chains are composed of from 50 to 100 or even 120 individuals. The sac which contains the parasites looks like a whitish tube, often bi- or trifurcate, flexuous, folded upon itself, floating in the lymph of the caterpillar outside of the intestine. Formed of a cuticular membrane, it is clothed on the interior with a layer of epithelial-like cells and encloses a fatty-albuminous mass in which the embryos are enclosed. Later, according to the observations of Bugnion, when the larvæ have attained a certain size, say at the end of May or the beginning of June, the string or chain, which may be 3.5 cm. long, presents a series of swellings and constrictions. Each swelling contains an undeveloped larva in the nutritive substance. At the end of June, the parasites having passed their first molt, break the epithelial tube which envelops them, and find themselves free in the body of the caterpillar. This period (second larval stage) lasts about eight days. Finally the larvæ, having cleaned out the interior of the caterpillar, each one pupates by enclosing itself in an ovoid cocoon, and the caterpillar, whose skin molds itself exactly upon these cocoons, becomes only a rigid, bossy mass. The change from the larva to the nymph takes place by a new molt, and about twenty days afterwards the *Encyrtus* emerges.

In 1898 Alfred Giard (*Bul. Soc. Ent. France*, pp. 127–129) published a note on the development of *Litomastix* (*Copidosoma*) *truncatellus*, a parasite of *Plusia gamma*, in which he describes precisely the same phenomenon previously described by the writer with the same parasite infesting *Plusia brassicæ*, but he reared more than three thousand specimens of the parasite from a single caterpillar. He showed that a single female can lay not more than a hundred eggs and that, therefore, since all of the parasites emerge at the same time, it is almost necessary to suppose that several females (twenty-five to thirty) simultaneously attacked the caterpillar. This, however, Giard thought was most unlikely, and he believed, therefore, that the phenomenon with *Plusia* must be explained on the basis of Paul Marchal's preliminary note published the same year. This leads us to Marchal's observations.

Dr. Paul Marchal, entomologist of the agronomic station under the Ministry of Agriculture at Paris, a naturalist trained in

the very latest morphological methods, a skilled embryologist, and a man of broad culture, in 1897 began to study the development of *Encyrtus fuscicollis,* a parasite of several species of the genus *Hyponomeuta;* publishing his preliminary announcement of his first discovery in the same year, indicating that from a single egg of the parasite there develop many true embryos. His announced results were received with the greatest interest in France, as evidenced by the appreciative remarks of Giard in his own article just cited.

With an admirable skill, with extreme powers of observation, and with an indomitable perseverance, Marchal continued these investigations during six or seven years, publishing four important papers, and finally, in 1904, his startling work entitled 'Recherches sur la Biologie et le Developpement des Hymenopteres Parasites'—La Polyembryonie Specifique ou Germinogonie, *Arch. Zool. Exp.* (4), Vol. II., pp. 257–335, pl. IX.–XIII.

The facts upon which he throws light may be summed up as follows, and in this summary the writer follows Bugnion:

1. The *Encyrtus* [*Litomastix* or *Copidosoma*] has, as well as its host the *Hyponomeuta,* a single annual generation.

2. The oviposition of the *Encyrtus* takes place after that of the *Hyponomeuta,* in July or in August, according to the species parasitized, and it is in the egg of the moth that the parasite introduces its own egg.

3. Each chain of embryos comes from a single egg, following the division of the germ into several distinct individuals in the morula phase.

4. A *Hyponomeuta* egg receives ordinarily only one *Encyrtus* egg. While it is possible that the *Hyponomeuta* egg may be pierced two or three times (perhaps by different individuals), in each case it forms in the caterpillar a corresponding number of chains of embryos.

5. The nutritive mass in which the embryos are encased results from the proliferation of the amniotic cells furnished by the germ of the *Encyrtus* (derived from the paranucleus).

6. The anhiste membrane, as well as the epithelial-like cellules which clothe the interior, are formed at the expense of mesenchymatal elements furnished by the organism of the host. These formations can be assimilated to an adventitious cyst destined to isolate the parasites.

It is upon the eggs of *Hyponomeuta malinella* that the act of oviposition of the *Encyrtus* was for the first time observed (1897).

Marchal having enclosed a branch of apple in a covering of gauze, placed some cocoons of the moth within. The adult insects emerged during the latter part of June and the early part of July. On the fourth several pairs copulated. On the sixth several freshly deposited egg masses were seen on the branches. On the eighteenth, a large number of *Encyrtus* having issued from parasitized caterpillars placed in the cage, Marchal noticed at half past one in the afternoon (at the time when the rays of the sun were warmest) an *Encyrtus* which, poised upon an egg batch of the *Hyponomeuta,* seemed to be about ovipositing. Profiting by such a favorable opportunity, he was able, during the four succeeding hours, to follow with a lens the minute parasite which passed from one egg batch to another, piercing the eggs with its ovipositor. The operation lasted each time a little more than half a minute (two minutes toward the end of the day).

Other observations were carried on upon the parasites of *H. mahalebdella.* As this insect issues later than the others, Marchal was able, thanks to this fact, to obtain new layings of the *Encyrtus* through a period extending from the twelfth to the twenty-second of August, and to complete at the same time the material which he needed for his work. He concludes from his latest observations that the *Encyrtus* does not live more than a dozen days in the imago state.

The search for the egg of the *Encyrtus* in the egg of the *Hyponomeuta* being extremely difficult if one is obliged to dissociate the vitellus, Marchal used the method of cross-section. Having collected on the tenth of September, 1901, the parasitized egg masses of *H. mahalebdella;* having fixed them in Gilson's liquid, colored with carmine and having cut them into fine sections, he succeeded in

discovering the egg of *Encyrtus* enclosed in the general cavity of the embryo of the *Hyponomeuta* already voluminous and well advanced. The size of the egg is so small that it was not possible to make more than four or five serial sections of its substance. Its contour is ovoid, distinctly limited, and there is no trace of the shell and pedicel observed before laying. There are in the interior five nuclei in the as yet undivided protoplasmic mass, of which four are smaller, rounded, equal in size, and one more voluminous, placed excentrically, of an irregular lobate form, presenting a finer and denser reticulum. It may be stated that the four little nuclei are destined to engender by successive proliferation all the chain of embryos while the larger nucleus (paranucleus or amniotic nucleus) constitutes the first outline of the amnion.

At this stage the egg of the *Encyrtus* is not surrounded by any membrane. One observes only in its neighborhood the presence of certain mesenchymatous cellules belonging to the host. It is a little later, when the number of embryonic nuclei has risen to eight or ten, that an adventitious cyst commences to form by the drawing together of the mesenchymatous elements which apply themselves against the egg and form a clothing of even cellules. As to the amniotic cellules derived from the paranucleus, their rôle is to form the albumino-fatty mass which surrounds the embryos and which serves indeed as food for the young larvæ.

At the end of September the little larvæ of the *Hyponomeuta* hatch, but they feed only upon the débris of the eggs and remain until springtime protected by the covering of the egg mass. In opening these larvæ under the microscope it is noted with certain ones that there are sometimes two or three little rounded bodies still difficult to distinguish floating among the viscera. These little bodies are the eggs of the *Encyrtus*. Examined by transmitted light at the end of autumn, the egg shows a globular or ovoid mass of protoplasm in which are situated, first, a mass of embryonic nuclei pressed together to the number of from fifteen to twenty; second, a large excentric paranucleus frequently divided into two segments.

This condition just described persists almost without modification through the winter. Meanwhile in a considerable number of eggs may be found, in the month of March and even in February, a grouping of the embryonic nuclei which already announces the division of the germ into several embryos. The formative vitellus (characterized by its clear tint) is divided into several rounded masses isolated from each other and each surrounding a group of nuclei. These last, which formerly had two nucleoli, now show multiple nuclei often placed in two rows.

But the phenomenon of polyembryony reaches its greatest intensity at the period when the young larvæ of the *Hyponomeuta* leave their winter shelter and commence to eat the leaves.

The egg, at first spherical, grows with an extraordinary rapidity and takes upon itself little by little an elongated ellipsoidal form. It is of this shape and with a considerably increased diameter that it is found in the interior of the larvæ of *H. cognatella* about the twentieth of April. The same condition is found in *H. mahalebdella* toward the tenth of May.

Studied at this time in a fine cross-section, the germ of *Encyrtus* is found to be composed of small, rounded masses, which have already in certain instances commenced to shape themselves at the end of winter.

Having become more numerous, these are formed of small collections of protoplasm surrounding the nuclei (to the number of eight to twelve to each mass) and offering already quite distinct cellular limits. Each one of these masses is lodged in a round and well-differentiated cavity hollowed out of the common nutritive granular protoplasm. These bodies, which may be likened to gemmules and which may be called hereafter muriform, increase by the multiplication of their elements until reaching a certain size—each one comprising then twelve to fifteen cellules—they divide by cleavage.

In the latter days of April, when the complex polygerm of *Encyrtus* has reached a half

millimeter in length and has taken the form of a sausage, there are about forty muriform bodies in the interior, all distinct from each other and surrounded by the common granular mass. The number of cellules which composes them is always somewhat reduced.

Toward the middle of May the complex polygerm has become a string of from three to four millimeters in length; the gemmules have multiplied until they are often more than a hundred. They have on an average twenty to forty cellules which, by reciprocal pressure, seem polygonal. From this period the embryonic buds begin to issue and the form of the body to become fixed. The embryo, abandoning its spherical form, becomes more discoidal and takes on a reniform aspect. This very characteristic form is generally found about the twenty-fifth of May with *H. cognatella*. Finally toward the tenth of June, the embryo having passed to the larval condition, the chains of the *Encyrtus* reach their definite length and show the typical form described at the beginning of this article.

The most striking fact in the development of the *Encyrtus* is then that a single egg placed in the egg of the moth proliferates by the division of the nucleus in such a way as to form a certain number of plurinuclear masses, and that these, dividing in their turn, give rise to as many morules as there will be embryos in each of the chains.

Polyembryony being, as appears from what precedes, the ordinary method of development of *Encyrtus fuscicollis*, one can predict that the study of the Chalcicidæ, especially of the Encyrtinæ, will show other analogous cases.

Marchal cites already *Ageniaspis testaceipes* Ratz., parasite of *Lithocolletis cramerella*, a miner of oak leaves. He has been able to see, it is true, only the advanced stages of the evolution of this species, his observation having been made in the month of October. The larvæ to the number of twelve or fifteen to each caterpillar had for the most part already formed their cocoons. But in some caterpillars the parasites were grouped in an epithelial tube similar to that of *E. fuscicollis*. The structure of the tube being absolutely the same, it is probable that the development goes on in the same way.

Another case of polyembryony has been observed by Marchal: *Polygnotus minutus* Lindeman, a minute prototrypid, .5 mm. long, parasite of the Hessian fly. The embryos, which are found to the number of ten to twelve in the gastric sac of the larva of the Hessian fly, are grouped in such a manner as to form a single ovoid mass.

The author, it is true, has not observed the *Polygnotus* in the act of oviposition, but, having found freshly-laid eggs in the gastric cavity, he has succeeded in following the multiplication of the nuclei, then the grouping of the cellules in several individuals as distinctly as with the *Encyrtus*. Polyembryony is then well established for this species. The only differences from *Encyrtus fuscicollis* are, first, that to the morula stage succeeds a true blastula with a central cavity before the formation of the embryo; second, that the proliferation of the germ being much less active, the number of individuals issuing from the egg does not appear to exceed twelve.

Following the publication of this remarkable paper, the subject of polyembryony was taken up by Dr. Filippo Silvestri, of the Royale Scuola Superiore di Agricoltura, at Portici, Italy, who published in 1905 a paper entitled 'Uno Nuovo Interessantissimo Caso di Germinogonia,' etc. (*Rendiconti della R. Accademia dei Lincei*, Vol. XIV., 2d sen., Serie 5ª, fac. 10°), which consisted of a preliminary note on the study of polyembryony with *Litomastix truncatellus*, the same species which had been observed by the writer and by Giard.

In 1906, in a paper entitled 'Contribuzioni alla Conoscenza Biologica degli Imenotteri Parassiti,'[1] the same writer, Silvestri, goes into detail, with text figures and plates, regarding a most interesting series of observations, in which he sums up practically as follows:

Litomastix truncatellus lays its egg in the egg of *Plusia gamma*.

[1] 1. Biologia del Litomastix truncatellus (Dalm.); 2d. Nota Preliminare, Portici, 1906, pp. 1–45, pl. I.–V.

The larva of *Plusia* parasitized by the *Litomastix* lives in summer three or four days longer than the healthy larva and reaches a greater size.

Each generation of the *Plusia* corresponds to a generation of the *Litomastix.*

The maturation of the egg is identical with fertilized and unfertilized (parthenogenetic) individuals. In the development of the egg of the *Litomastix* we have a process of germinogony or specific polyembryony, quite different from that found by Marchal in *Encyrtus fuscicollis* and *Polygnotus minutus.*

From one egg of *Litomastix* there originate about a thousand sexual larvæ and some hundred or more asexual larvæ. The first transform into adults, while the second are destroyed, serving probably as aids to the sexual larvæ in lacerating the internal organs of the host larvæ.

Asexual larvæ are notable from their form, in the structure of the exoskeleton, and by the lack of a circulatory system, of a respiratory system, of the malpighian tubules, and, above all, of the reproductive system.

Each embryo of the sexual or asexual larva is surrounded by two involucres, of which the external one is derived from the ooplasm and the polar nucleus; the internal from a layer of cellules derived by delamination from the embryonal morule.

The fecundation of the egg with *Litomastix* determines the female sex.

And now, what are the broad bearings of this interesting work?

Giard had already in 1898, in his note cited above, in discussing the value of Marchal's discovery as announced in his preliminary note, stated that if one wishes to seek in other classes of animals embryonic peculiarities comparable to those revealed by Marchal, it is perhaps in the degraded platyhelminths of the families Orthonectidæ and Dicyemidæ that something analogous may be found. The sporocysts of *Rhopalura* are in effect, he stated, filled with embryos by a process of ovular multiplication which is not unlike that which takes place in the embryonal tubes of the *Encyrtus.*

Marchal himself publishes an important section entitled 'Relations existing between Specific Polyembryony of the Hymenoptera and Other Modes of Agamic Reproduction.' These instances are well summed up by Bugnion in a paper entitled 'La Polyembryonie et le Déterminisme Sexuel' (*Bulletin de la Société Vaudoise des Sci. Nat.,* XLII., No. 153, March, 1906), in which he also includes a consideration of certain additional observations, and we may adopt in a very free translation Bugnion's summary:

Other examples taken from the whole range of the animal kingdom somewhat approach the polyembryony of insects.

With the cyclostomes (Bryozoa) one finds a budding which takes place in the egg at the beginning of development. In the genus *Lichenopora* this budding is replaced by the dissociation of the primitive embryo into a great number of secondary embryos. We have then here a phenomenon comparable to that which we have seen with the parasitic Hymenoptera. It is necessary to note, however, that the secondary embryos thus formed offer already an indication of embryonic buds, while the morules of *Encyrtus* or the blastules of *Polygnotus* present no apparent differentiation. With other Bryozoa (*Lophopus, Cristatella*) there is also to be seen a budding in the egg, but this takes place at a later period.

With the worms, Kleinenberg announced in 1879 the curious case of *Lumbricus trapezoides,* in which the egg develops into two embryos; here the multiplication takes place by a sort of internal budding intervening in the gastrula stage, at which time differentiation of the buds is already effected.

With the tunicates, the species of *Diplosoma* offer a curious case of precocious budding which gives the appearance of the simultaneous formation of two embryos in the same egg, but in reality this proceeds from the internal budding of an embryo already differentiated (Salensky, Caullery, Pizon, Perrier). With *Pyrosoma* the budding also takes place in the egg, but by a slower method, and it is only when the embryo is organized that it pushes out a ventral stolon immediately cleaving transversely into four buds which each

develop into a new individual (according to Huxley, Kovalevsky, Seelicer, etc.).

From the cases mentioned, where the budding takes place in the egg, one passes insensibly to more frequent and better-known phenomena in which agamic reproduction takes place after the individual has already issued from the egg (as in the Cœlenterates, Orthonectidæ, Dicyémidæ, Platyhelminths, Tunicates). The preceding observations seem then to establish a continuous series connecting the polyembryony of Hymenoptera with the cases of agamogenesis occurring in advanced stages of development.

In general the facts of polyembryony may be also said to approach the cases of experimental blastotomy recently observed by various authors.

Dreisch (1892), passing a temperature of 31° over the eggs of echinids, obtained a separation of the blastomeres into two or more groups; and Loeb (1893), by mixing distilled water in equal parts with the sea-water in which the eggs were found, produced the same result.

Another experiment of Loeb, 1894, upon the eggs of *Echinus,* and by Bataillon, 1900, upon the eggs of *Petromyzon* and of teleosts, consists in dissociating the egg into several groups of blastomeres by means of a heated needle. Both obtained complete larvæ, each blastomere or group of blastomeres forming an embryo.

Ryder in 1893 obtained double monsters by the shaking of the eggs of trout. The vitellus forming on both sides of the egg made two distinct individuals.

One can even make two complete larvæ of *Triton* united only by the skin of the abdomen, by constricting the egg with a silken thread (Endres 1895, Speman 1900 and 1901).

These facts favor, it may be seen, what is called the isotropic condition of the egg, each blastomere or group of blastomeres isolated by one of the methods indicated being capable of forming a complete individual.

Marchal expresses this very well in saying that both in spontaneous polyembryony and in experimental blastotomy each part of the egg contains the complete hereditary patrimony capable of ending in the formation of an individual conforming to the specific type.

In the papers of Marchal and Bugnion no reference is made to the recent very important work of Professor Conklin in which he shows that the eggs of the Ascidians, *Cynthia partita* and *Ciona intestinalis,* are not isotropic and that the cytoplasm of the egg is not equipotential. Dr. Conklin concludes that "Experiments which demonstrate the totipotence of blastomeres or regions of the egg prove nothing with regard to the presence or absence of differentiation in these parts. Some eggs with a high degree of differentiation have at the same time great capacity for regulation." Workers in this field must reckon with these important results.

Another question which presents itself is that of knowing whether among insects polyembryony ought to be considered as having preceded or followed phylogenetically the other methods of agamic reproduction such as pædogenesis among the Cecidomyiidæ or cyclical parthenogenesis among the Aphididæ and the Cynipidæ. Harmer, for the Bryozoa, arrived at the conclusion that embryonic scission is a consequence of the blastogenetic faculty of the adults. Perrier extends the same point of view to all budding animals.

Considered from this point of view, the polyembryony of the Chalcididæ appears not as an initial phenomenon, but as a secondary adaptation due to an acceleration of embryogenetic process (*tachygenesis* of Perrier, 1902). The result of this adaptation is, considering the short and precarious existence of the adult *Encyrtus,* to assist in the preservation of the species by pushing its multiplication to the highest possible degree.

As to the determining cause of the division of germ, Marchal thinks that it is from the sudden surrounding with more dilute liquids in the interior of the nourishing mass and in a concomitant modification of the osmotic exchanges in the interior of the cellules. One sees, in fact, with *Encyrtus* that polyembryony reaches its greatest intensity at the moment when the larva of the *Hyponomeuta* commences to feed (in the early days of April), and for the *Polygnotus* at the period

when the young larva of the Hessian fly engorges itself with sap. Now, the production of the rapid changes bringing about osmotic pressure constitutes precisely the procedure employed to bring about the separation of the blastomeres and their evolution into several distinct individuals, as has been shown by the experiments already mentioned of Loeb and Bataillon.

Polyembryony is connected with the question of the fixation of sex, and offers from this point of view an especial interest.

Bugnion observed already in the course of his studies upon *Encyrtus* (1891) that all of the individuals coming from a single caterpillar most often belonged to a single sex. A total of twenty-one observations carefully controlled gave the following result: five times of males exclusively; nine times of females exclusively; three times a great majority of males; once a great majority of females; three times males and females in nearly equal numbers.

Marchal has stated similarly that with *Polygnotus*, those coming from a single larva of the Hessian fly almost always belong to the same sex.

These facts, which Bugnion thought should be attributed to an occasional parthenogenesis (the caterpillars giving birth exclusively to males having been, according to his supposition, those which had been pierced by a non-fertilized *Encyrtus*), are now to be explained in a much more rational manner.

With man, true twins enclosed in the same chorion probably come from a single egg. While different hypotheses have been suggested, especially lately (Rosner, 1901), it is natural to suppose that twins develop by the separation of the egg into two parts (spontaneous blastotomy). Then it is established that true twins are always of the same sex. Exceptions to this rule are explained by the fact that certain unusual twins are formed by the joining of two eggs.

Another case presents itself with the mammals, which seems much more comparable to those of *Encyrtus* and *Polygnotus*, namely, that of the armadillo (*Dasypus* or *Tatusia*). These animals give birth, according to the species, to a litter of from four to eleven young which are all and always of the same sex. It has been noted by Ihering (1886) that all of the fœtuses are enveloped in a common chorion and belong, therefore, to the type of true twins. Rosner (1901) explains this fact by the habitual presence of several ovules in a single graafian follicle, and has even concluded that all of the cases of monochorial multiple birth can be explained in the same way. But Cuenot (1903), reviewing the question, has found that with the species studied by Rosner (*Tatusia novemcincta* Linnæus) the monovular follicles are twenty times more numerous than the pluriovular follicles. It is then impossible to admit that the latter only furnish the fertilizable eggs, and the author concludes that, according to all probability, the multiple births of armadillos come from a single egg.

The discovery of Marchal, therefore, comes extremely apropos to throw new light upon this interesting and greatly discussed question. In the cases where *Encyrtus* and *Polygnotus* issuing from the same larva are almost all males or all females, it must be admitted that this is a natural consequence of polyembryony, and that one would expect the sexes to be separated in this way wherever the embryos come from the division of a single egg.

The fundamental fact coming from this study is that every caterpillar or larva which contains a single chain of embryos gives birth to imagos of the parasite belonging to a single sex, but as the same caterpillar frequently contains two or three chains it will not be astonishing to find males and females given out in quite equal number. The cases in which we find individuals of both sexes, but in unequal numbers, are to be explained by the partial aborting of one of the chains and the survival of only a few individuals, while the other chain develops normally.

It is seen, therefore, that the discovery of polyembryony confirms a fact already suspected but until now incompletely demonstrated, and that is that *the determination of the sex in the fecundated egg is definitely brought about before the first segmentation*

of its nucleus. If then the facts drawn from the observation of parasitic Hymenoptera apply equally to the higher animals, it will be inexact to speak, as has sometimes been done, of an embryonic period which is indifferent from the sexual point of view. The indifference is probably apparent rather than real, and it appears probable that once fecundation is effected the sex is irrevocably fixed.

It is strange that Marchal's work and that of Silvestri following it have received so little attention from English-speaking naturalists. The extraordinary nature of the discoveries and their wide bearing upon profound biological problems render them among the most important discoveries in biology of recent years. Recently published volumes on insects contain no mention of them; no competent reviews have been published in American or English journals, so far as I am aware, and it is for the sole purpose of directing the attention of American workers to this extremely important field that I have written this lengthy account. After reviewing one of Marchal's preliminary papers in Science in 1898, I endeavored to induce several university teachers, possessing well-equipped laboratory facilities, to take up the subject of this investigation, but without success. It is a fertile field. In the parasitic Hymenoptera there are many thousands of species, and an unlimited material exists at our very doors. The most promising fields of investigation have recently been pointed out by the writer in a paper read before the Entomological Society of Washington. Marchal has studied two or three species; Silvestri has studied another; and both workers have found radical and interesting differences in all. There is, therefore, a vast and unexplored field whose richness can well be predicted from the results of Marchal's work. L. O. Howard.

LE FONDULE (FUNDULA CYPRINODONTA) OF CARBONNIER AN UMBRA.

I have been several times asked what the Fondule of Carbonnier (1874) was. The breeding habits of this American fish were noticed in considerable detail by P. Carbonnier in the *Bulletin Mensuel de la Société d'Acclimatation* for November, 1874 (pp. 665–671), but under a strange name which has evaded and even prevented identification. The article in question is entitled 'Le Fondule (*Fundula cyprinodonta* Cuv.)' and it is especially claimed: "Ce poisson américain a été désigné par Cuvier sous le nom de *Fundula cyprinodonta*." But Cuvier never gave such a name to a fish, neither in the first or second edition of the 'Régne Animal,' nor (with Valenciennes) in the 'Histoire Naturelle des Poissons.' Carbonnier was probably told by some one who looked casually at his fish that it was a *Fundulus*, a cyprinodont, but the slight notice given of it by Carbonnier does not agree with any cyprinodont. The only means he has given to determine what it was are meager data respecting size, color, sexual differences and habits. The size was small—12 to 15 centimeters at most; there were numerous longitudinal parallel lines; there was no constant difference in color between the sexes, but the females were twice as large (bulky) as the males; they were noticeable for immobility[1] and also for apparent power to turn the head.[2] Here we have a combination of characteristics which is not true of any cyprinodont but which is on the whole realized by an Umbra or mudfish (*U. pygmæe*), and doubtless specimens of that mudfish (to be found abundantly about New York) were the fishes sent to Carbonnier. The sender was a 'M. Godillot,' a Frenchman doing business in New York, as appears from a previous notice by Carbonnier in the *Bulletin* (1871, p. 650).

Interesting details are given of the play of the sexes, the change in color during the nuptial season, the mode of oviposition, the care of the female for her eggs[3] and the char-

[1] L'immotilité qui est un caractère de cette espece (p. 666).

[2] J'ai dit elle tourne la tête, et avec intention, car cet organe chez le Fondule paraît ne pas être invariablement soudé à la charpente du tronc, et jouit, au contraire, d'une certaine mobilité (p. 669).

[3] Pendant tout le temps que dure l'incubation, qui est de treize à quatorze jours, la femelle veille avec une tendre sollicitude sur ses œufs (p. 669).

acteristics of the larval fish. These were the first observations made on the breeding *Umbra* and should be repeated before they are fully accepted. Although many years ago I kept several specimens in a small aquarium, no attempt to breed was noticed, and none has been observed in an aquarium of the U. S. Fish Commission containing a number of them. I therefore call attention to the interesting article by Carbonnier.

THEO. GILL.

NOTES ON PHYSICS.

THE TUNGSTEN LAMP.

MANY readers of SCIENCE may be interested to know that 'the electric lighting industry is face to face with a change of almost revolutionary character,' to quote from the concluding paragraph of a paper read before the American Institute of Electrical Engineers by Dr. C. H. Sharp, of the Electrical Testing Laboratories of New York City, on Friday evening, November 23.

The two papers of the evening were, a paper by Dr. C. P. Steinmetz on the general aspects of the problem of the transformation of electric power into light, and one by Dr. Sharp on some tests of new types of incandescent lamps; and the subject was discussed by several investigators who are working upon the problem of the tungsten lamp in this country.

It is generally conceded that within a year an electric glow lamp, the tungsten lamp, will be on the market and that the output of light per unit of power consumed will be increased at least threefold above that which is now obtained by the carbon filament glow lamp; which means that the light-producing capacity of every electric lighting station in the world will be at once multiplied by three, and that there will be at once the possibility of greatly reduced prices per unit of light and greatly increased profits to the electric lighting companies.

Those who are interested in the scientific or technical aspects of the problem of electric lighting will find it worth their while to read the papers of Dr. Steinmetz and Dr. Sharp in the forthcoming monthly issue of the *Proceedings of the American Institute of Electrical Engineers*.

NORMAL VERSUS SELECTIVE RADIATION. SELECTIVE EXCITATION.

To obtain a highly efficient lamp is either to discover a substance which will stand an excessively high temperature under which conditions a very large percentage of the radiant energy is light, or to discover a substance which at a moderately high temperature radiates selectively and gives off a large percentage of luminous radiation. Thus the Welsbach gas light owes its high efficiency very largely to the selective radiation of thorium and cerium oxides.

The idea of selective radiation is, however, profoundly modified in most illuminants and made to depart widely from that form of the idea which is based upon thermodynamics, where the idea grows out of the necessarily complementary character (in a substance nearly in thermal equilibrium) of emission, transparency and reflection.[1]

This modification of the idea of selective radiation is so important in the problem of light production that it should be more generally recognized, and its very intimate connection with that principle in the kinetic theory of gases which is known as the principle of the equi-partition of energy should be pointed out. Indeed, this modification of the idea of selective radiation is intimately connected with the apparent inapplicability of the principle of the equi-partition of energy.

Jeans has shown that the apparent failure of the principle of the equi-partition of energy in a gas may be explained by the hypothesis that when energy is given to a gas in a particular form, say as energy of translational molecular motion, it takes a very long time for this energy to become properly partitioned among all the possible modes of molecular motion.

The application of Jeans's idea to the question of selective radiation is that when energy

[1] See Nichols & Franklin's 'Elements of Physics,' Vol. III., chapter on Radiation for an outline of the argument.

in a particular form is imparted to a substance it spreads out very slowly among the various possible modes of molecular motion and if the substance is losing energy continuously by radiation we must have a very wide departure from black body radiation because of the wide and persistent departure of the substance from thermal equilibrium. I think this departure of the radiation of a substance from black body radiation should be attributed to its actual cause, selective excitation, and it should not be spoken of as selective radiation in the strict sense of that term.

The extent to which the radiation from a selectively excited substance departs from black body radiation or rather from its own characteristic normal emission (when it is nearly in thermal equilibrium) depends greatly upon the speed at which the energy of a given mode of molecular motion spreads out into all the possible modes, and we have evidence that this speed of spreading is very slow even in many solid and liquid substances. Thus we have in the fire-fly a case of selective excitation and the wide departure of the radiation of the fire-fly from normal black body radiation shows that the energy which is developed by the selective excitation is nearly all radiated before it spreads out to any great extent among the various possible modes of motion.

In the case of the Welsbach mantle it is not at all certain that we have a genuine case of selective radiation free from the effects of selective excitation, for, although the exciting agent in this case is the extremely disordered movements of combustion, still even the disordered movements of combustion do no doubt depart very widely from the type of molecular motion which would exist in the same substance in thermal equilibrium.

When energy is imparted to a glowing substance by the electric current, whether the substance be solid, or liquid, or gas, we have in all probability a strongly marked case of selective excitation.

The upshot of this whole matter is that in the solution of the important problem of the efficient production of light we are not constrained by the thermodynamic laws of radiation, and not to a very great degree dependent upon selective radiation properly so called, but we are left free in the field of unlimited possibilities of selective excitation and we may look forward with some hope of a highly efficient lamp independently of the discovery of a substance which will stand temperatures of many thousands of degrees.

In the tungsten lamp we have certainly a filament which stands a very high temperature (several hundred degrees higher than the carbon filament can stand), we have a filament which certainly shows selective radiation in the strict sense of this term, and we have most certainly some degree of selective excitation. To what extent the high efficiency of the tungsten lamp is to be attributed to one or another of these three things it is impossible to decide from present data.

In the mercury-vapor lamp and in the titanium-arc lamp we have certainly a substance (a vapor) which can stand an unlimited degree of temperature, but we know that the vapor is not very hot in either case; also in both lamps the light-giving vapor most certainly shows selective radiation in the strict sense of this term, and in both cases we most certainly have very pronounced selective excitation. Furthermore, in the case of a gas or vapor it seems that the speed of spreading out of a given mode of molecular motion into all possible modes is very slow, so that selective excitation in a vapor or gas shows itself in very pronounced departure of the radiation from the normal characteristic radiation of the given gas or vapor.

The most striking instance of selective excitation as shown by extremely abnormal radiation is that afforded by the long-continued glow of the air in a Geissler tube *at liquid-air temperature* after the cessation of the exciting current. It seems, indeed, that the lower the temperature of a substance the slower the energy of a given exaggerated mode of molecular motion spreads into other modes, and the higher the temperature the more this spreading is accelerated. A remarkable consequence of which is that a selectively excited gas should be cold to give the greatest possible luminous efficiency, whereas a very hot gas

when selectively excited tends to give off perceptible intensities of radiation corresponding to every possible mode of molecular motion.

Another aspect of increased rapidity of spreading of energy among the various modes of motion of a gas with increased temperature is that the spectrum of a very hot gas when excited by the electric current tends to show many lines that are invisible when the gas is relatively cool. Thus the spectrum of the mercury arc has no red lines when the vapor is relatively cool, but when the vapor is very hot red lines appear.

W. S. FRANKLIN.

NOTES ON ORGANIC CHEMISTRY.

THE NITRATION OF ANILINE.

IT is generally stated in text-books of organic chemistry that aniline and nitric acid, of tolerably high concentration, yield resinous, tarry, or carbonaceous material from which no definite compounds can be isolated, whereas, in the presence of a large excess of concentrated sulphuric acid, nitration of the aniline takes place without difficulty. This behavior is explained by assuming that in the first case the nitric acid attacks the amino group of aniline more readily than it affects the benzene nucleus, but that the former is 'protected' by the concentrated sulphuric acid.

Several objections can be made to this explanation, among which the following may be mentioned: (1) Aromatic amines form stable compounds (nitrates) with nitric acid, but with nitrous acid the products (nitrites, diazonium derivatives, etc.) are, in general, highly unstable. (2) The primary products of the action of aniline on nitric acid or sulphuric acid are, presumably, aniline nitrate, $C_6H_5NH_3NO_3$, and aniline hydrogen sulphate, $C_6H_5NH_3SO_4H$, respectively, and it is not apparent why the amino group is less well 'protected' in the former compound than in the latter.

Guided by these and other considerations, we began, some months ago, a study of the action of nitric acid on aniline and on aniline nitrate, and of the behavior of certain derivatives of aniline towards nitric acid alone and when mixed with acetic acid, oxalic acid, trichloracetic acid and sulphuric acid, respectively. The aniline derivatives employed included only those in which one or both of the hydrogen atoms of the amino group have been replaced, such as acetanilide, $C_6H_5NHCOCH_3$, or oxanilide,

$$\left.\begin{array}{l} CO \\ | \\ CO \end{array}\right> NC_6H_5.$$

A preliminary account of our work has recently appeared,[1] and we hope to publish further communications on the subject in the course of a few months. The object of this note is to call attention to certain of our results which we think may be of some general interest. Nitric acid of any concentration up to 75.33 per cent. when mixed with aniline in equimolecular proportion forms the nitrate, provided a suitable temperature is maintained, but the slightest excess of acid, if of comparatively high concentration, changes this colorless nitrate to a reddish pink compound. This may be kept for a day or two if it remains sufficiently cool, but, more or less quickly, depending on the temperature and on the excess of acid, it darkens, blackens and may become incandescent. The color is instantly discharged by a drop of water and is regenerated by more acid.

In the formation of mononitro derivatives of the substituted anilines referred to above, the position taken by the nitro group (ortho, meta, para) appears to depend on two factors: (*a*) the nature of this substituting group, *i. e.*, whether it be negative (acidic), positive (basic), or neutral; (*b*) the strength, not concentration, of the acid which has been mixed with the nitric acid. Should this conclusion be justified by our subsequent experiments, it will be seen that, as we can vary each of the above factors between very wide limits, the possibility is afforded of varying *a* in the same direction as *b* or in an opposite one, in order to prepare some desired isomer. Moreover, similar conditions might reasonably be expected to apply to the nitration of compounds in general, and if to nitration, then also, so far as experi-

[1] *Amer. Chem. Jour.*, **36**, 605 (1906).

mental conditions permit, to other similar reactions involving substitution.

We desire to call special attention to the discovery that acetic acid and sulphuric acid play a definite part in determining the position of the entering nitro group, because, heretofore, the belief has been quite general that when present with nitric acid the function of the sulphuric acid was confined to withdrawing from the sphere of activity the water formed during the process of nitration, while the acetic acid was regarded as a diluent to reduce the activity of the nitric acid. Oxalic acid and trichloracetic acid do not appear to have been previously employed in nitration experiments.

J. Bishop Tingle,
F. C. Blanck.
Johns Hopkins University,
November 24, 1906.

NOTES ON THE HISTORY OF NATURAL SCIENCE.

SIR JOHN MANDEVILLE.

To that dauntless literary freebooter of the fourteenth century who styled himself Sir John Mandeville, and whose 'Voiage and Travaile' enjoyed for a long time enormous popularity, very little consideration is given by historians of natural science. Yet this extraordinary compilation contains many matters of interest to the zoologist, botanist and even geologist of our day, to say nothing of its value from a purely literary or philological standpoint.

A fruitful theme for investigation has been an analysis of the sources, contemporary, early medieval and ancient, from which the narrator made wholesale robberies. Claiming to have been the traveling companion of Friar Odoric, the Bohemian (1286–1331), he appropriated bodily large portions of that noted traveler's itinerary, and precisely these portions are of chief interest to the naturalist. Concerning this question of sources, one may consult the splendid bilingual edition published by the Roxburghe Club, with notes by Mr. Warner, of the British Museum, and the valuable essay by Albert Bovenschen, published by the Berlin Geographical Society in 1888.

A point of interest to the geologist is Sir John's mention, in chapter 8, of the eruptive condition of Etna and the Lipari Isles. Very incomplete records have been preserved of early Liparian eruptions, and it would be interesting to find the statement confirmed by other writers that 'there be seven swelges that burn.' In the original French version this passage concludes: "Et de Ytaille iusques a ces volcans nad pluis de xxv. lieuez; et dit homme qe ces sunt chymenes denfern." This last remark is evidently a localization of a familiar legend, but whether original or not on the part of the author is hard to say. A parallelism exists, though I am not aware of any one having called attention to it, with one of the 'Dialogues' of St. Gregory, where the hermit of Lipari is described as having seen Theodoric the Great, on the day of his death, carried in bonds between Pope John and Symmachus, and thrown into the Volcano of Lipari. It was also a popular belief during the middle ages that Charles Martel had been banished within the crater of Stromboli.

Concerning the animal lore scattered throughout Sir John's book, it has been observed that "all the old legends of the Alexander saga and of the 'Miracles of the Orient'[1] are here amalgamated with much that is new about those fabulous monsters with which the medieval fancy populated the mysterious East." Yet besides these fables there is much authentic information of real value. A single point, of minor interest to be sure, is worth mentioning on account of its having engaged Cuvier's attention. A curious subversion of the Andromeda legend occurs in chapter 5 of Mandeville's book, where it is said that one of the ribs of the monster found at Joppa measured forty feet in length. The statement is evidently borrowed from Solinus (chapter 34), who obtained his information in turn from Pliny ('Nat. Hist.,' v. 14; ix., 4). According to the latter, the total length of the creature, whose bones were conveyed to Rome and exhibited there, was forty feet; and as shown by Cuvier, the description could not have applied to any other animal than a whale.

[1] References to the spread of this literature are given in Science, Vol. 23, p. 195.

Other instances of the stranding of whales are reported by the same classic author.

C. R. EASTMAN.

CURRENT NOTES ON METEOROLOGY.

LANTERN SLIDES FOR TEACHING METEOROLOGY.

THE Geographic Society of Chicago has done an excellent work for the development of meteorological instruction in the United States. It has collected a set of 270 lantern slides of various meteorological subjects. It has published a good descriptive text to accompany them. It sells the slides at cost. This is one of the more important meteorological contributions along educational lines which has been made in this country within the last few years. The plan was inaugurated in 1905 by Dr. J. Paul Goode, then president of the Chicago Geographic Society, and on the committee which was put in charge of the work were Dr. Goode, Professor Henry J. Cox, of the U. S. Weather Bureau in Chicago, the chief observer of the Weather Bureau in Chicago, and three teachers. The slides are copied from maps and diagrams in the *Atlas of Meteorology*, recent text-books, and in the *Monthly Weather Review;* from photographs, and from weather maps and weather records selected and prepared by the committee. A wide range of subjects is covered, and any teacher of meteorology, climatology or geography will surely find many slides suitable for use in his particular line of teaching. The text to accompany the slides embraces 130 pages. It includes a 'General Introduction,' by Professor Cox; a paper on 'The Use of the Lantern in Teaching Meteorology,' by Dr. Goode; a short working bibliography for the use of teachers, and then the descriptive text (110 pages). The latter is subdivided according to the subjects covered by the slides, including the following: weather observatories; meteorological instruments and instrument records; temperature distribution; atmospheric pressure and circulation; sunshine and other optical phenomena; humidity, cloudiness and precipitation; cyclones and anticyclones; thunderstorms and tornadoes; floods; synchronous weather conditions; life response to climate. This descriptive text is almost a small text-book in itself, and will be very helpful to teachers (unless perchance it be so complete that it tempts them to limit their reading to this alone). We welcome most heartily the Chicago Geographic Society's valuable contribution to meteorological education.

LAND AND SEA BREEZES ON THE GERMAN COAST.

THE phenomena of land and sea breezes on the eastern coast of Germany bordering the Baltic have been studied by Max Kaiser, of Halle ('Inaugural-Dissertation,' Halle, 1906), who has made use of anemograph records for the period 1901–5 at five stations extending over a strip of 300 miles of coast-line; of the observations taken thrice daily at storm-warning stations of the Deutsche Seewarte, and of observations on light-ships and on passing vessels. The sea breeze was found to begin at various times, often at 8 A.M. and often not until 2 P.M. or later. The absolute maximum velocity was 13.2 miles per hour; the absolute minimum was 0.8 miles per hour. The mean velocity is 4.5 to 6.7 miles per hour. April to September are the months of occurrence. Only those days were taken as sea-breeze days which had an offshore wind early, an onshore wind at noon and an offshore wind again in the evening. The 'roundabouts' which have been noted on the New England coast and in other places are but partially developed on the Baltic coast of Germany. An interesting study of the place of beginning of the sea breeze, based on observations from vessels offshore, makes a decided addition to our present knowledge on this subject. In the region under discussion the sea breeze, when conditions are favorable, begins between four and five nautical miles offshore, and the land breeze extends as far out as eight nautical miles.

MONTHLY WEATHER REVIEW.

No. 8, Vol. 34, 1906, of the *Monthly Weather Review* contains the following papers: 'The International Symbols,' by H. H. Clayton. It is pointed out that the American term 'frostwork' is equivalent to the German 'Rauhfrost,' and the English term 'silver thaw' is the equivalent of the Amer-

ican 'ice storm.' 'The Meteorological Optics of Professor J. M. Pernter' is a review of Pernter's standard work, recently published, by Professor R. W. Wood. 'The Meteorological Conditions Associated with the Cottage City Waterspout' (August, 1896), by Professor F. H. Bigelow. A full review and discussion of the weather conditions leads to the conclusion that a sheet of cold air, in front of an approaching anticyclone, overran the lower, warmer air, the cold air following at the surface a few hours later. This gave 'the exact conditions required to produce the observed powerful convection.' 'Variation in Temperature over a Limited Area,' by Professor W. I. Milham, of Williams College, embodies the results of studies at Williamstown, Mass., supplementary to those previously discussed in the *Monthly Weather Review* (July, 1905) by the same writer. 'Monthly Review of the Progress of Climatology throughout the World.' This is a comparatively recent addition to the regular contents of the *Review;* the notes are prepared by C. F. Talman, and will be found useful by teachers of meteorology and climatology. 'The First Daily Weather Map from China,' by the same writer, notes the publication of this new map on July 1, 1906.

CLIMATE OF FORT GRANT, ARIZONA.

WE note the publication of a paper on 'The Climate of Fort Grant, Graham County, Arizona' in the *Journal of the Outdoor Life* for November. The writer is Dr. I. W. Brewer, and special attention is paid to the relations of this climate to disease.

R. DEC. WARD.

EVENING TECHNICAL COURSES AT COLUMBIA UNIVERSITY.

THE Board of Extension Teaching of Columbia University announces a series of nine evening technical courses which will be given at the University this winter, beginning December 3, and lasting twenty weeks. The courses are under the immediate direction of Professor Walter Rautenstrauch, of the Faculty of Applied Science, and are to be given by professors and instructors of the university and other persons especially qualified. Moderate fees ($7.50 to $15) are charged and most of the courses are for two evenings a week. The courses are as follows:

Engineering Physics.—As illustrated in the mechanical plants of modern buildings. (1) An elementary study of physics: (2) a practical study of steam and electrical machinery, heating, ventilating, water system, wiring, elevators, etc., included in the plant of Columbia University. For two classes of students: those wishing an introductory study of physics as preparation to advanced study in electricity, steam, etc., another winter; those desiring practical training for positions as superintendents of buildings, engineers, janitors, etc.

Elementary Mathematics.—Those parts of arithmetic, algebra, geometry and trigonometry used in technical work. Practice with engineering hand-books, tables, etc.

Drafting.—A beginner's course; fits for positions as draftsmen; reading of drawings, etc.

Strength of Materials.—A lecture course for those who design or manufacture machinery, or modern structures. With this course should be taken either the first or second of the two following courses in design.

Machine Design.—Advanced drafting, computations, and designing for persons engaged in the design and manufacture of machinery.

Structural Design.—Advanced drafting, computations, and designing for those who do structural work.

Electrical Engineering.—A course especially for those engaged in electrical work of any sort.

Steam Engineering.—A course for those engaged in the manufacture or management of steam machinery of any sort.

Special Engineering Problems.—A study of any special elementary or advanced engineering problems desired by the student: Individual instruction will be arranged for such a period of time as the special problem may demand.

The courses will be given in the buildings of Teachers College, Columbia University, at West 120th Street and Broadway, which affords necessary lecture rooms, laboratories, drafting rooms, etc. A complete catalogue of these courses will be sent on request, by addressing Evening Technical Courses, Extension Teaching, Columbia University. Personal information may be secured on Tuesday

and Thursday evenings, between 7:30 and 9 o'clock from Mr. Benjamin R. Andrews, Room 111, Teachers College.

PROFESSOR OSBORN AND THE SECRETARYSHIP OF THE SMITHSONIAN INSTITUTION.

PROFESSOR HENRY FAIRFIELD OSBORN has declined the secretaryship of the Smithsonian Institution, to which he was elected by the regents on December 4. His letter to Hon. Melville W. Fuller, chancelor of the Smithsonian Institution, dated New York, December 11, contains a full statement of all the reasons which, after reconsideration, finally render Professor Osborn unable to accept the post of secretary. Chief among these reasons is the fact that he is nearing the completion of several monographs and books, the prosecution of which is dependent upon the collections which he has brought together in New York and the staff of trained assistants who are working with him. Among these works especially is the 'History of the Tertiary or Fossil Mammals of North America,' the 'Titanothere Monograph' and the 'Sauropoda Monograph' for the United States Geological Survey, which were begun by the late Professor O. C. Marsh, a monograph on the evolution of the horse in preparation for the American Museum of Natural History series, also a popular volume on the evolution of the horse to be published by Columbia University, in addition to a large number of minor or supplementary papers and researches. The main tenor of Professor Osborn's letter is shown in the following abstract:

I was absolutely taken by surprise and deeply moved by your generous action in voting to elect me to the most honorable post of Secretary of the Smithsonian Institution. It is the greatest honor I have received or expect to receive; yet after several days which I have devoted almost exclusively to reflection on this matter from every standpoint, I find myself unable to accept your invitation.

I desire to explain to you fully why I have reached this conclusion, and I trust I may be able to convince you it is through no lack of the sense of public duty which should inspire every American. I hope I may convince you also that acceptance would involve a change of career just at a time when I am trying to publish the results of thirty years of research. These results would have been partly or entirely in print at this time had it not been that for the past sixteen years I have been interrupted and drawn away by executive and administrative work of the *very* character which would be demanded of your new secretary on a grander scale. The possibility of *continuing and completing these researches and at the same time serving the office as it should be served* is the point on which my attention has been centered during the past few days.

As to *time for research*, my friend Dr. Alexander Graham Bell in the course of two conferences has assured me that the Regents especially desire an investigator as well as an administrator; in other words, that the secretary should continue his scientific researches, whatever they may happen to be, and I have tried to convince myself that even with my peculiar temperament I might be able to withdraw from time to time to pursue and complete these publications. On this point I have chiefly reflected, reviewing my experience here in far less responsible positions. Naturally there is some strong pressure here against my acceptance of the post; but to reach an impartial conclusion I have listened chiefly to those who *desire to see me accept*. In these conferences and among the numerous letters of congratulation which I have received from scientific workers in all parts of the country, I have not found one to hold out the hope or expectation that my scientific researches will continue even as they have in the past. I am myself convinced that even with the assured cooperation of a very able staff, the ideal development of the Smithsonian with all its auxiliary institutions will require nothing less than the entire time, thought, energy, and strength of the secretary for four or five years to come. The quiet days of Joseph Henry and even of Spencer F. Baird in this country have passed. The enormous growth of the country, the telephone, the telegraph, the wireless, the great newspaper, make the seclusion and quiet absolutely essential for research increasingly difficult every day.

Failure in the post or anything short of complete success would disappoint you and would disappoint the public, who naturally cannot appreciate the undisturbed conditions essential to the prosecution of successful intellectual work. Other men may be so constituted as to assume a grand office like the secretaryship, with its splendid possibilities for the future, and not have it

on their minds day and night; unfortunately perhaps, I am not so constituted.

The matter of *materials* for the completion of my work presents a still more serious difficulty, because palæontology differs substantially from many other branches of zoology. We have here the finest palæontological collection in existence, as the result of sixteen years of exploration and purchase, a staff of over twenty highly trained assistants, preparators, field workers and artists, all harmoniously working toward a common end. The opportunity could not be recreated in Washington because it is in a branch of pure science which least of all bears upon human welfare and happiness and is, moreover, extremely expensive. As secretary of the Smithsonian I could not conscientiously recommend the annual appropriation of $25,000 to $30,000, to this branch, and I know I should not have the support of Congress for other more vital subjects if I did. In other words, a change of residence would cut me off from my materials of research.

In brief, I have finally and for many reasons very regretfully reached the conclusion that the secretaryship would mean a change of career, just at the moment when I feel that without selfishness I am on the point of bringing out the results of many years' labor. I trust that these results are really important, that they will tend to advance American science, and that they will inspire younger men to broad and thorough standards and to strive for absolute truth rather than for brilliant and short-lived generalizations.

I hope I have been able in this long letter to win you over to the point of view which I have reached after most conscientious reconsideration of this matter, and that I shall retain the confidence and esteem which prompted you to vote for me, which I value far more highly than I can possibly express. May I beg also that you will make it generally understood that I am clearly unable to reach any other decision.

PRELIMINARY PROGRAM OF THE NEW YORK MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND THE AFFILIATED SCIENTIFIC SOCIETIES.[1]

Wednesday, December 26.

Registration.—Hotel Belmont, opposite the Grand Central Station, W. 42d Street.

Executive committee of the council of the American Association. Hotel Belmont, noon.

Smokers. Hotel Belmont and Murray Hill Hotel, 8:30 P.M.

Thursday, December 27.

Registration. Earl Hall, Columbia University (Broadway, Amsterdam Avenue and 116th St.). To be reached by subway express trains on Broadway from the hotel headquarters and railway terminals.

Council of the American Association. Trustees Room, Library, Columbia University, 9 A.M.

General session. Introduction of the president of the meeting, Dr. William H. Welch, Johns Hopkins University, by the retiring president, Dr. C. M. Woodward, Washington University. Welcome by President Butler, Columbia University. Announcements. Earl Hall, 10 A.M.

Organization of Sections.—Addresses of Vice-president F. W. McNair in mechanical science and engineering; Vice-president George Grant MacCurdy on 'Some Phases of Prehistoric Archeology.' Programs of Sections.—The sections will meet as follows: Mathematics and Astronomy, 506 Fayerweather Hall; Physics, 301 Fayerweather; Chemistry, 309 Havemyer; Mechanical Science and Engineering, 302 Engineering; Geology and Geography, 305 Schermerhorn; Zoology, 618 Schermerhorn; Botany, 502 Schermerhorn; Anthropology, 306 Mines; Social and Economic Science, 301 Engineering; Physiology and Experimental Medicine, College of Physicians and Surgeons, West 59th Street. These meetings will be held at 11 o'clock, following the adjournment of the general session.

Luncheon. University Commons, Columbia University—table d'hote, 30 cents, à la carte, 5 cents and upwards, 12 to 2 P.M.

Address of Vice-president W. S. Eichelberger, of the U. S. Naval Observatory, before the Section of Mathematics and Astronomy. Vice-president C. F. Mabery, Case School of Applied Science, on 'The Education of the Professional Chemist.' Vice-president William North Rice, Wesleyan University, on 'The Contributions of America to Geology.' Vice-president Henry B. Ward, University of Nebraska, on 'The Influence of Parasitism on the Host.' Vice-president Wm. T. Sedgwick on 'The Expansion of Physiology.' These addresses will be given at 2:30 P.M.

[1] This program contains only certain of the main features of the meeting. Members should secure the program of the American Association, which will be distributed at Earl Hall on December 27, and the programs of the special societies in which they are interested.

Programs of the sections and societies in their respective rooms, in the main as given above, 2 or 2:30 P.M.

Section of Physiology and Experimental Medicine. Discussion on 'Protozoa as Factors in the Diseases of Animals and Plants.' College of Physicians and Surgeons, 3:30 P.M.

Meeting of the council of the American Chemical Society, 3:30 P.M.

Address of the retiring president of the American Association, Dr. C. M. Woodward, on 'Science in Education,' Horace Mann Hall, Teachers College, Columbia University (Broadway and 120th Street), 8 P.M.

Reception by the president of Columbia University. Earl Hall, 9 to 11 P.M.

Smoker. Faculty Club, Columbia University, 9.30 P.M.

Friday, December 28.

Registration, validation of railway tickets, etc. Earl Hall.

Council of the American Association. Trustees room, 9 A.M.

Meetings of the sections and societies in their respective rooms, 10 A.M. and earlier.

Joint meeting of the Section of Mathematics and Astronomy, the American Mathematical Society, the Astronomical and Astrophysical Society of America. Room 405, Schermerhorn Hall, 10 A.M.

Joint meeting of the Section of Physiology and Experimental Medicine and the American Bacteriological Society. Rockefeller Institute for Experimental Medicine (66th Street and Avenue A), 10 A.M.

Geological Society of America. American Museum of Natural History, 10 A.M.

Luncheon, 12 to 2 P.M.

Luncheon. The Schultz Mineral Water Company (440 First Avenue), for the American Chemical Society and Section C, followed by excursions.

Address of Vice-president Henry Crew, Northwestern University, on 'Fact and theory in Spectroscopy.' Vice-president Erwin F. Smith, U. S. Department of Agriculture, on 'Problems of Plant Physiology.' Vice-president Irving Fisher, Yale University, before the Section of Social and Economic Science, 2:30 P.M.

The sections and societies will meet at 2 or 2:30 P.M. in their respective rooms.

Meeting of the American Society of Naturalists. 305 Schermerhorn Hall, 2:30 P.M., followed by a discussion at 3:30 on 'The Biological Significance and Control of Sex,' by Dr. A. F. Blakeslee, Harvard University; Professor F. R. Lillie, University of Chicago; W. T. Swingle, U. S. Department of Agriculture; Professor E. B. Wilson, Columbia University; Professor R. A. Harper, University of Wisconsin; Professor T. H. Morgan, Columbia University; J. B. Nichols, Washington.

Address by President William James before the American Philosophical Association on 'Surplus Stores of Energy.'

Dinners. The American Society of Naturalists. University Commons, Columbia University. The American Chemical Society, the American Geological Society of America and other societies and groups, places to be designated, 6:30 or later.

Address of Vice-president Davenport, on 'Cooperation in Science,' before the American Society of Naturalists. 8 P.M.

Smoker of the American Society of Naturalists. Faculty Club, 9 P.M. Other smokers and informal meetings have also been arranged.

Saturday, December 29.

Registration, etc. Earl Hall.

Council of the American Association. Trustees room, 9 A.M.

Meetings of the societies and sections. 10 A.M. and earlier.

Botanical Society of America. Botanical Garden, morning and afternoon.

Addresses. Professor C. F. Chandler, Columbia University, on 'The Electrical Industries of Niagara Falls.' Dr. John M. Clarke, of the Science Division, New York State Educational Department, on 'The Effort to Save Niagara.' Townsend Harris Hall, City College (138th Street and Amsterdam Avenue), 12 o'clock, followed by a complimentary luncheon in the gymnasium and an inspection of the new buildings.

Unveiling of ten marble busts of American men of science with addresses. American Museum of Natural History, 3 P.M.

Reception by the trustees of the American Museum of Natural History and the council of the New York Academy of Sciences; exhibit of scientific progress by the New York Academy of Sciences with demonstrations and short addresses. American Museum of Natural History, 8 P.M. The exhibit will also be open on Friday afternoon and evening and on Saturday afternoon.

Address of the president of the American Chemical Society, Dr. W. F. Hillebrand, U. S. Geological Survey, on 'The Present and Future of the American Chemical Society,' Chemists Club (108 West 55th Street), 8 P.M.

Smoker. Chemists Club, 9 P.M.

Monday, December 31.

Registration, etc. Earl Hall.

Council of the American Association. Trustees room, Columbia University, 9 A.M.

Meetings of the sections and societies, 10 A.M. or earlier; 2:30 P.M. or earlier.

Luncheon, 12 to 2 P.M.

Complimentary dinner to the President of the Association by men of science of New York City. University Club, 7:30 P.M.

Banquet of Sigma Xi. Place and time to be designated.

Nominating Committee. Hotel Belmont, 9:30 P.M.

Tuesday, January 1.

Registration, etc. Earl Hall.

Council of the American Association. Trustees room, Columbia University, 9 A.M.

General session. Earl Hall, 10 A.M.

Meetings of the sections and societies, 10 A.M. or earlier; 2:30 P.M., or earlier.

Luncheon. 12 to 2 P.M.

The societies that will meet in New York City in convocation week and their officers are as follows:

American Association for the Advancement of Science.—December 27–January 1. Retiring president, Professor C. M. Woodward, Washington University, St. Louis, Mo.; president-elect, Professor W. H. Welch, The Johns Hopkins University, Baltimore, Md.; permanent secretary, Dr. L. O. Howard, Cosmos Club, Washington, D. C.; general secretary, Dr. John F. Hayford, U. S. Coast and Geodetic Survey, Washington, D. C.; secretary of the council, President F. W. McNair, Houghton, Mich.

Local Executive Committee.—J. J. Stevenson, chairman; C. C. Adams, Charles Baskerville, Franz Boas, N. L. Britton, H. C. Bumpus, Chas. A. Conant, Simon Flexner, Wm. J. Gies, Wm. Hallock, Alex. C. Humphreys, G. S. Huntington, Edward Kasner, Henry F. Osborn, C. L. Poor, Clifford Richardson, E. B. Wilson, Frederick J. E. Woodbridge, J. McKeen Cattell, secretary.

Section A, Mathematics and Astronomy.—Vice-president, Professor Edward Kasner, Columbia University; secretary, Professor L. G. Weld, University of Iowa, Iowa City, Iowa.

Section B, Physics.—Vice-president, Professor W. C. Sabine, Harvard University; secretary, Professor Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

Section C, Chemistry.—Vice-president, Mr. Clifford Richardson, New York City; secretary, Professor Charles L. Parsons, New Hampshire College, Durham, N. H.

Section D, Mechanical Science and Engineering.—Vice-president, Mr. W. R. Warner, Cleveland, O.; secretary, Professor Wm. T. Magruder, Ohio State University, Columbus, Ohio.

Section E, Geology and Geography.—Vice-president, Dr. A. C. Lane, Lansing, Mich.; secretary, Dr. Edmund O. Hovey, American Museum of Natural History, New York, N. Y.

Section F, Zoology.—Vice-president, Professor E. G. Conklin, University of Pennsylvania; secretary, Professor C. Judson Herrick, Denison University, Granville, Ohio.

Section G, Botany.—Vice-president, Dr. D. T. MacDougal, Washington, D. C.; secretary, Professor F. E. Lloyd, Desert Botanical Laboratory, Tucson, Arizona.

Section H, Anthropology.—Vice-president, Professor Hugo Münsterberg, Harvard University; secretary, George H. Pepper, American Museum of Natural History.

Section I, Social and Economic Science.—Mr. Chas. A. Conant, New York City; secretary, Dr. J. F. Crowell, Bureau of Statistics, Washington, D. C.

Section K, Physiology and Experimental Medicine.—Vice-president, Dr. Simon Flexner, The Rockefeller Institute for Medical Research; secretary, Dr. Wm. J. Gies, College of Physicians and Surgeons, Columbia University, New York City.

The American Society of Naturalists.—December 28. President, Professor William James, Harvard University; secretary, Professor W. E. Castle, Harvard University.

The Astronomical and Astrophysical Society of America.—December 27. President, Professor E. C. Pickering, Harvard College Observatory; secretary, Professor Geo. C. Comstock, Washburn Observatory, Madison, Wis.

The American Physical Society.—President, Professor Carl Barus, Brown University; secretary, Professor Ernest Merritt, Cornell University, Ithaca, N. Y.

The American Mathematical Society.—December 28, 29. President, Professor W. F. Osgood, Harvard University; secretary, Professor F. N. Cole, Columbia University.

The American Chemical Society.—December 27–January 2. President, Professor W. F. Hillebrand, U. S. Geological Survey; secretary, Dr. William A. Noyes, the Bureau of Standards, Washington, D. C.

The Geological Society of America.—December 26–29. Acting president, Professor W. M. Davis, Harvard University; secretary, Professor Herman L. Fairchild, Rochester, N. Y.

The Association of American Geographers.—December 31–January 1. President, Cyrus C. Adams, New York City; secretary, Albert P. Brigham, Colgate University.

The American Society of Zoologists.—December 27, 28, 29. President (Eastern Branch), Professor W. E. Castle, Harvard University; secretary, Professor H. S. Pratt, Haverford College. President (Central Branch), Professor C. C. Nutting, University of Iowa; secretary, Professor T. G. See, University of Michigan.

The Association of Economic Entomologists.—December 28, 29. President, A. H. Kirkland, Malden, Mass.; secretary, A. F. Burgess, Columbus, O.

The Society of American Bacteriologists.—President, Dr. E. F. Smith, U. S. Department of Agriculture; secretary, Professor S. C. Prescott, Massachusetts Institute of Technology.

The American Physiological Society.—December 27, 28, 29. President, Professor W. H. Howell, the Johns Hopkins University; secretary, Professor Lafayette B. Mendel, 18 Trumbull St., New Haven, Conn.

The Association of American Anatomists.—December 27, 28, 29. President, Professor Franklin P. Mall; secretary, Professor G. Carl Huber, 333 East Ann St., Ann Arbor, Mich.

The Botanical Society of America.—December 27, 28, 29. President, Dr. F. S. Earle; secretary, Dr. William Trelease, Missouri Botanical Garden, St. Louis, Mo.

The American Psychological Association.—December 27–28. President, Professor James R. Angell, University of Chicago; secretary, Professor Wm. Harper Davis, Lehigh University.

The American Philosophical Association.—December 27–29. President, Professor William James, Harvard University; secretary, Professor John Grier Hibben, Princeton University.

The American Anthropological Association.—December 27–January 3. President, Professor F. W. Putnam, Harvard University; secretary, Dr. Geo. Grant MacCurdy, Yale University, New Haven, Conn.

The American Folk-lore Society.—December 27–January 3. President, Dr. A. L. Kroeber, University of California; secretary, W. W. Newell, Cambridge, Mass.

New York State Science Teachers Association.—December 26, 27. President, John F. Woodhull, Teachers College, Columbia University.

All railways have granted a rate of one and one third fare for the round trip to those attending the meeting. Certificates should be obtained for the meeting of the American Association for the Advancement of Science.

SCIENTIFIC NOTES AND NEWS.

DR. WILLIAM H. WELCH, professor of pathology in the Johns Hopkins University, and Dr. Henry S. Pritchett, president of the Carnegie Foundation, have been elected trustees of the Carnegie Institution.

THE New York Academy of Sciences held its annual meeting on December 17. Following the dinner Dr. N. L. Britton, director of the New York Botanical Garden, gave the presidential address. The officers for next year are as follows:

President: Nathaniel L. Britton.

Vice-Presidents: Section of Biology, H. E. Crampton; Section of Geology and Mineralogy, Amadeus W. Grabau; Section of Astronomy, Physics and Chemistry, Charles C. Trowbridge; Section of Anthropology and Psychology, Robert MacDougall.

Corresponding Secretary: Richard E. Dodge.

Recording Secretary: Edmund Otis Hovey.

Treasurer: Emerson McMillin.

Librarian: Ralph W. Tower.

Editor: Chas. Lane Poor.

Councilors: To serve three years, William M. Wheeler, Charles Baskerville.

Finance Committee: John H. Caswell, George F. Kunz, Frederic S. Lee.

PROFESSOR T. W. RICHARDS has been elected an honorary member of the Royal Institution of Great Britain.

MR. ALEXANDER AGASSIZ has chartered the steam yacht *Virginia* for a cruise to the West Indies. The yacht will sail from New York the first week in February to be absent for three months.

PROFESSOR RICHARD E. DODGE, of Teachers College, Columbia University, has been made an honorary member of the Royal Geographical Society of Australasia. He will contribute a paper on 'The Geographer and School Geography' to the twenty-first anniversary meeting, at Queensland.

The Journal of the American Medical Association states that the fact that the Nobel prize this year has been awarded to Cajal and Golgi has roused their compatriots to do them

exceptional honor. It has been proposed that one street in Madrid and one in Pavia be named after Cajal and Golgi, respectively, and the name of Golgi is to be given to one of the hospitals of Pavia. Various other projects also are being discussed. It is reported that Cajal may be knighted and made a senator for life and that endowed prizes may be given in his name.

Professor John R. S. Sterrett, of Cornell University, sailed on December 15 for Athens with a party which will spend two years in archeological field work in the near east.

Mr. William E. D. Scott, curator of ornithology at Princeton University and director of the Worthington Society for the Investigation of Bird Life, is spending the winter at Trudeau, New York, in the interest of his health, on a six months' leave of absence from the laboratory of the Worthington Society at Shawnee, Pennsylvania.

Professor G. W. A. Luckey, of the department of education of the University of Nebraska, has been given a leave of absence for the next semester to allow him to go abroad to study secondary education in European countries.

Dr. R. S. Woodward, president of the Carnegie Institution, gave an address on 'Technical Education' at the meeting of the Washington Society of the Massachusetts Institute of Technology on December 12.

Dr. William R. Brooks, director of the Smith Observatory and professor of astronomy at Hobart College, Geneva, N. Y., delivered two illustrated astronomical lectures recently before the Franklin Institute, Philadelphia. The subjects were 'Other Worlds than Ours' and 'The Evening and Morning Stars.'

Sir Victor Horsley's Hughlings Jackson lecture before the Neurological Society of the United Kingdom on November 29 was entitled 'The Illustration by Recent Research of Dr. Hughlings Jackson's Views on the Functions of the Cerebellum.'

On December 12, 1906, in the chapel of the University of Nashville, a portrait of Gerard Troost was unveiled with appropriate ceremonies. Troost was the pioneer geologist of the state of Tennessee, was state geologist from 1831 to 1850, and was professor of geology, mineralogy and chemistry in the University of Nashville from 1828 to the time of his death in 1850. Addresses were made by James D. Porter, LL.D., chancellor of the university; J. I. D. Hinds, Ph.D., LL.D., professor of chemistry, and P. H. Manning, A.M., professor of geology. The geological building and the cabinet which it contains have also been named in honor of Gerard Troost.

A statue of the late Principal Viriamu Jones, F.R.S., first principal of the University College of South Wales and Monmouthshire and the first senior vice-chancellor of the University of Wales, was unveiled at Cardiff on December 1 by Viscount Tredegar. The statue, which is the work of Mr. Goscombe John, A.R.A., has been placed temporarily in the new city hall, but will be removed to the new college buildings when they are completed.

Mr. Arthur Vaughan Abbott, a well-known electrical engineer in New York City, author of important works on telephony and electrical transmission of energy, has died from pneumonia at the age of fifty-two years.

Fitzhugh Townsend, A.B., E.E., instructor in electrical engineering at Columbia University, died of typhoid fever on December 11, at the age of thirty-four years.

Sir Edward J. Reed, F.R.S., chief constructor of the British navy from 1863 to 1870 and later lord of the treasury and member of parliament, died on November 30, aged seventy-six years.

The Central Branch of the American Society of Naturalists and Affiliated Societies will hold its next annual meeting during the Easter vacation, at the University of Wisconsin. There will consequently be no conflict with the convocation week meeting in New York City.

The following lectures will be given during the winter by Lewis M. Haupt, Sc.D., professor of civil engineering of the Franklin Institute, Philadelphia. 'The Chesapeake and

Delaware Canal as the Keystone of the Coastwise System,' before the Franklin Institute, December. 'The Relation of the Government to its Waterways,' at the Carnegie Institute, Pittsburg, January 10, to be followed by an address to the Pittsburg Board of Trade on the 'Railroad Crisis' on the next evening, January 11. The Connecticut Society of Civil Engineers will entertain Professor Haupt at its annual banquet on February 12 (Lincoln's birthday), when it will hear his address on 'Transportation Economics.' On Washington's birthday he will address the students of the Sheffield Scientific School at New Haven on 'Commercial Waterways and their Economics.' The College of Engineering of Cornell University has in view a lecture on the 'Isthmian Canals' at a date to be determined.

AT the anniversary meeting of the Royal Society it was announced that in May last the council learned that the funds (£36,000) provided by the British South Africa Company for the South African meridian arc had been exhausted. The arc had been extended beyond the Zambezi towards Lake Tanganyika, but a gap of 120 miles existed in the middle of it. It was estimated that £1,600 was required to fill this gap, and the matter was most urgent in view of the pending disbandment of the surveying parties. The officers had intimated by authority from the president that the Royal Society would probably be able to subscribe £300 from its private funds on condition that the remainder of the money required were provided; and, on the strength of this information, Sir G. Darwin obtained a promise of £800 from the British South Africa Company, £100 from the Royal Geographical Society, £100 from Wernher, Beit and Co., and cabled to Sir David Gill that the surveying party was to proceed, thus assuming responsibility for the remaining £300. This £300 has since been subscribed by the British Association from its special South African fund.

WE learn from the London *Times* that what is probably the largest male mandrill (*Papio mormon*) ever received at the London Zoological Gardens has just been deposited, and will be exhibited in the open-air cage at the west end of the monkey-house. At present it is in temporary quarters in a stout traveling cage on the green at the back of the anthropoid house. Lest unwary visitors should be tempted to overstep the low railing and feed the mandrill, the cage bears a label, 'This animal is dangerous.' This baboon, native in West Africa, from Senegambia to the Congo, presents a remarkable appearance from its ungainly form and strange coloration. Its body is stoutly built, with short powerful limbs and massive head sloping from the occiput to the muzzle; the ears are small and triangular, and the large circular nostrils pig-like in having a raised border. No other baboon shows such striking color contrasts; the fur is blackish olive, the nose red, and on each side of the face are large transverse sausage-shaped swellings of a light blue tint with the grooves between them deep purple; the beard is citron yellow, and the seat pads are scarlet. No large mandrill has been exhibited in the gardens for nearly thirty years; in 1878 a female in the collection produced a hybrid young one to a male macaque (*Macacus cynomolgus*). A young Kashmir stag (*Cervus cashmirianus*) has been presented by the Duke of Bedford, from the herd at Woburn, and placed in the deer sheds. Only once before has the species been representd in the collection, and from the official catalogue that appears to have been so long ago as 1865. This deer is somewhat larger than the red deer; dark reddish brown above, lighter beneath and the rump patch dirty white. There is no cup in the antlers, and the tines on each side are normally five, though eight have been noted in Mr. Rowland Ward's 'Records of Big Game.' In the pairing season old stags squeal like wapiti instead of roaring like red deer, and the spotting in the fawns persists much longer than it does in fawns of the last-named species. Captain Pam has once more presented a fine collection of South American birds, principally tanagers and finches, most of which are now on view in the insect-house. The only species determined as new to the

collection is a green toucan (*Aulacorhamphus sulcatus*), though a grosbeak and two siskins remain to be identified.

UNIVERSITY AND EDUCATIONAL NEWS.

ANNOUNCEMENT has been made by President Charles F. Thwing that gifts of $100,000 each have been made to Western Reserve University, Cleveland, O., by Mr. H. M. Hanna and Colonel Oliver H. Payne. The $200,000 thus subscribed is to be used in establishing and endowing a laboratory of experimental medicine in the medical school. A professorship of experimental medicine has been created and Professor George N. Stewart, of the University of Chicago, has been elected to the chair, the first of its kind, it is said, to be created in this country.

THE trustees of Hobart College have accepted the proposition of Mr. William Smith, of Geneva, N. Y., to found a woman's college. The name of the new college will be the William Smith College for Women, and it will have an endowment of about $350,000. The new college will have five members on the board of trustees, two of whom must be women. Two new buildings will be erected, a dormitory and a biological and psychological laboratory, to be known as the William Smith Hall of Science.

MR. JOHN D. ROCKEFELLER has sent word to the Board of Foreign Missions of the United Presbyterian Church that he will give $100,000 toward educational work in Egypt and the Soudan.

A 'CARL SCHURZ memorial professorship' is to be established at the University of Wisconsin as a result of the movement recently started in Milwaukee by a number of prominent German-Americans. The plan is to raise an endowment of $50,000, the income of which will be used for the establishment of an annual course of lectures at the state university, to be given by prominent professors of German universities. It is hoped that the establishment of this new chair will lead to an exchange of professors between the University of Wisconsin and German universities.

PRESIDENT PLASS, of Washburn College, Topeka, Kans., a congregational institution, has announced that Mr. Andrew Carnegie has offered to give the college a second $50,000 for its endowment fund, provided the total endowment reaches $200,000 by January 1, 1908.

ACCORDING to a cablegram from Tokio members of the Furukawa family, who are prominent Japanese mine owners, have given 1,000,000 yen (about $500,000) to establish the nucleus of new universities at Fukuoka, Sapporo and Sendai.

As a result of Bishop O'Connell's mission to Japan the Vatican will establish shortly a Catholic University at Tokio. It will be controlled by Jesuits of the American province.

DR. A. LAWRENCE ROTCH, the founder and director of the Blue Hill Meteorological Observatory, has been elected professor of meteorology at Harvard University.

DR. A. E. HALSTEAD has been elected professor of surgery in the Northwestern University Medical School.

AT the annual meeting of the trustees of Oberlin College on December 5 it was voted that under the provisions of the Carnegie Foundation retirement is to be at the option of the teacher or college at the age of sixty-five, but obligatory at sixty-eight. The office of dean of the college of arts and sciences was created, and Charles E. St. John, professor of physics, was elected to the office. Mr. Earl F. Adams, now at Harvard University on leave of absence, was made associate principal and associate professor of physics in the academy. Dean Edward T. Bosworth was granted leave of absence for the second semester. Two associate professorships were created, one in English and one in political science. The bids for the new library exceed the $125,000 given by Mr. Carnegie. After some modifications in the plans bids will be obtained again.

MR. F. J. DYKES, M.A., fellow of Trinity College, Cambridge, late lecturer in mechanics at the Royal Naval College, Portsmouth, has been appointed lecturer in mechanics at Trinity College.